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Measuring Fertility Intentions During Times of Crisis: An Example Using Survey Data Amid the Covid-19 Pandemic

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Fertility intentions-intentions regarding whether and when to have children—predict reproductive health outcomes. Measuring fertility intentions is difficult, particularly during macrostructural shocks, for at least two reasons: (1) fertility intentions may be especially volatile during periods of uncertainty and (2) macrostructural shocks may constrain data collection. We propose a set of indicators that capture how a macrostructural shock directly alters fertility intentions, with a particular focus on the Coronavirus disease 2019 (Covid-19) pandemic. We advance the conceptualization and construct of fertility intentions measures in three ways. First, we demonstrate the value of direct questions about whether women attributed changes in fertility intentions to the pandemic. Second, we highlight the importance of a typology that delineates fertility postponement, advancement, foregoing, and indecision. Third, we demonstrate the importance of incorporating a granular time window within a two-year period to capture short-term changes to fertility intentions. We exemplify the value of our proposed measures using survey data from a probabilistic sample of women aged 18-34 in Pernambuco, Brazil. We discuss the self-reported change in intentions due to Covid in wave 1 as well as panel change across waves. We further ground our contributions by uncovering important variations by social origin and parity.

INTRODUCTION

Fertility intentions—measures of intent regarding whether and when to have children are important predictors of reproductive outcomes (Kodzi, Johnson, and Casterline 2010; Müeller et al. 2022; Speizer and Lance 2015; Yeatman and Sennott 2015; Yeatman, Trinitapoli, and Garner 2020; Yeatman and Trinitapoli 2020) and maternal well-being (Mark and Cowan

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2022). Regardless of whether a person's fertility intention and fertility behavior are concordant, fertility intentions are a central feature of women's lives as they reflect one's surrounding social and health structures (Bachrach and Morgan 2013) and help identify variations in women's autonomy over their reproductive lives (Yeatman, Trinitapoli, and Garner 2020). Measuring fertility intentions, however, presents a challenge because they are dynamic and sensitive to changes at the micro-, meso-, and macro-levels (Axinn and Barber 2001; Johnson-Hanks 2014; Müeller et al. 2022; Sennott and Yeatman 2012; Trinitapoli and Yeatman 2011, 2018). At the same time, while fertility intentions change throughout people's life course and over time (Hayford 2009; Liefbroer 2009; Müeller et al. 2022), such volatility is socially patterned and its measurement is conceptually and theoretically relevant (Kodzi, Johnson, and Casterline 2010; Trinitapoli and Yeatman 2018; Yeatman, Trinitapoli, and Garner 2020).

The multiple challenges of measuring fertility intentions¹ become more pronounced during periods of extreme structural uncertainty—such as the Covid-19 pandemic—for at least two reasons of theoretical and practical relevance. First, fertility intentions are likely to be especially volatile during periods of extreme uncertainty. For example, fertility preferences are especially volatile in times of uncertainty (Trinitapoli and Yeatman 2018) and economic crisis (Agadjnanian 2005). The Covid pandemic represents a unique macrostructural period, generating unforeseen levels of unpredictability in everyday life with uncertainty overlapping multiple domains, such as economic, health, and labor market dimensions. Second, the pandemic imposed constraints on data collection that required creative ways to measure the impacts of Covid-19 on fertility intentions in real-time.

The goal of this paper is, therefore, to describe direct and granular indicators of fertility intentions that contribute to a broader understanding of how these processes are shaped by macrostructural crises in general, and by the Covid-19 pandemic in particular. We detail how insights from the *Demographic Consequences of Zika and Covid-19 Epidemics (DeCodE)* project—a population-representative panel survey of 3,996 women aged 18–34 conducted in 2020 in Pernambuco, Brazil with subsequent annual waves—can facilitate the construction of these indicators. Although our study is longitudinal, in this paper, we focus primarily on cross-sectional measures of fertility intentions. Because panel data collection is expensive and labor intensive, a cross-sectional strategy can be instructive for survey efforts that face similar limitations, particularly those fielded in low- and middle-income countries.

In describing the measures of fertility intentions from the DeCodE survey, we provide comparisons with standard indicators of fertility intentions to show how our measures provide insight into (shifting) intentions during a period of intense crisis. Although fertility desires and intentions are often used interchangeably, we follow research that contends that fertility intentions refer to intentional behavior and planning, which differ from fertility desires (Kost and Zolna 2019). As we show through three research aims, our succinct measures capture several important dimensions of fertility intentions, as described in the following

¹ We distinguish between fertility desires and intentions. While most of the demographic literature uses the term "fertility intentions" when using data that in fact reflect "fertility desires" (e.g., DHS), we align our conceptualization with our instrument (Kost and Zolna 2019) to measure fertility intentions as the intentional behavior in women's reproductive lives ("Do you intend to have a(nother) baby at some point in your life?"; "After this baby that you're expecting is born, do you intend to have another baby at some point in your life?"). To that end, we join the effort of using accurate language to characterize experiences (Kost and Zolna 2019). Our survey contains additional measures of fertility intentions and desires, but for this paper, we focus on fertility intentions.

paragraphs, including changes due to the pandemic in intention to have a(nother) child, in intended timing, as well as unsurety around having a(another) child.

Our first aim is to demonstrate the utility of distinguishing between intentions to forego or postpone childbearing. We define the foregoing as the intention to permanently avoid childbearing. We consider that women intend to postpone childbearing when they report that they intend to have a child(ren) and report that the timing for this intention is later than six months. We focus on fertility postponement as a separate category because of the significance of fertility postponement mindsets, that is, short-term or temporary fertility avoidance without clear goals for long-term fertility, at times of socioeconomic and political uncertainty (Hayford and Agadjanian 2019; Timæus and Moultrie 2008). Our design allows us to measure postponement intentions and analyze if/how the macro-level uncertainties presented by the pandemic push women to incorporate short-term, long-term, or indefinite delays into their childbearing timelines until conditions improve. Our measures also identify indecision/unsurety in fertility intentions. Conceptually investigating the indecision in fertility intentions amidst the Covid-19 pandemic is another contribution of this study, a consideration that is particularly important during this period of extreme uncertainty.

Our second aim is to highlight the importance of capturing temporal granularity in fertility intentions during an ongoing macrostructural crisis. Whereas most studies examining fertility intentions distinguish between people who intend to become pregnant within two years and people who intend to become pregnant after two years (Croft et al. 2018), we argue that this classification might obscure how sudden disruptions from a structural crisis shapes short-term postponement intentions.

Our third aim is to describe variation in respondents' intentions temporally and by sociodemographic characteristics. We do this by describing respondents' intentions at the start of the pandemic—baseline wave 1—and, subsequently, throughout the first year of the pandemic—wave 2. We also show how flexibility in fertility intentions at the onset of the pandemic is patterned by social origin and parity.

Overall, we show that alternate data collection strategies can capture granular and direct yet succinct indicators of shifts in women's reproductive lives due to macrostructural uncertainty. We argue that cross-sectional surveys can be designed to measure (perceptions of) changes in fertility intentions amid structural crises such as the Covid-19 pandemic. With scientists predicting an "era of pandemics" of novel infectious diseases (Hinchliffe, Manderson, and Moore 2021), such crises will continue to impact how individuals navigate major life intentions, such as pregnancy and childbearing. The need for tailored fertility intention indicators that reflect this new reality and that can also be efficiently implemented in lowand middle-income countries becomes crucial.

This paper is structured as follows. First, we briefly discuss measures of fertility intentions. We then introduce the DeCodE study. We next describe the analytical sample and variables we used. We then show how the indicators of fertility intentions constructed using the DeCodE data contribute to the literature in three key ways—by linking individual-level fertility intentions to a macrostructural crisis; by providing a granular typology that delineates postponing, foregoing, advancement, and indecision both cross-sectionally and longitudinally; and by examining flexibility in fertility intentions because of Covid-19 by social origin and parity at the emergence of Covid-19 and throughout the first year of the pandemic. We conclude by discussing the strengths and weaknesses of our measures and reflecting on the next steps to uncovering flexibility in fertility intentions across a period of extreme uncertainty globally.

METHODS

Measuring Fertility Intentions

Measuring fertility intentions presents inherent challenges for researchers due to the dynamic nature of intentions and their sensitivity to changes at the micro-, meso-, and macro-levels. Structural shocks, such as a major public health crisis, are characterized by high levels of societal uncertainty and disruption that exacerbate these challenges. In the case of a novel infectious disease outbreak, in particular, women must consider their fertility intentions in an ever-shifting context where knowledge about the disease is initially very limited but rapidly evolving. Thus, measuring changes in fertility intentions in response to a macro-level shock— and in particular, the Covid-19 pandemic—requires a targeted set of indicators that captures both how women perceive the direct impact of the shock on their fertility intentions and the nuanced ways in which the shock might affect their intentions.

Surveys measuring fertility intentions typically rely on a set of questions that ask about intentions to have (more) children (e.g., "Do you want/intend to have a(nother) child?") and the desired timing of an intended pregnancy (e.g., "When do you intend to get pregnant?"). Prior research on structural shocks and fertility intentions has relied on these general measures of intentions from both longitudinal and cross-sectional surveys to examine the sensitivity of fertility intentions to such shocks (Brauner-Otto and Axinn 2017; Sellers and Gray 2019; McKenzie 2003). However, such general measures do not directly capture whether women themselves attribute changes in their intentions to the shock.

Few recent cross-sectional surveys have directly measured perceptions of change in fertility intentions in response to the Covid-19 pandemic and with questions that permit examination of the nuanced ways in which the pandemic might influence fertility intentions. Zhu et al. (2020) and Kahn et al. (2021) conducted surveys on fertility intentions relative to Covid-19. While they asked participants to recall their intentions prior to the pandemic and their current intentions during the pandemic, they did not ask respondents to indicate whether Covid-19 changed their intentions. Luppi, Arpino, and Rosina (2020) asked individuals if the pandemic changed their fertility plans at all, but respondents did not report the timing of their fertility plans. Lastly, Malicka, Mynarska, and Świderska (2021) identified respondents who wanted children within three years prior to the pandemic and asked whether Covid-19 altered their plans.

The DeCodE project directly assessed women's changes in fertility intentions and in the timing of intended pregnancy in response to the Covid-19 pandemic and whether they attribute those changes to the pandemic. We combined standard measures of intentions with explicit questions about perceived changes in fertility intentions due to Covid-19. Our survey asked these questions first in wave 1, allowing for women to assess retrospectively, in the early months of the Covid-19 pandemic, whether changes in their fertility intentions (and timing) were due to the pandemic. We then asked these questions again in wave 2, allowing us to measure a change in intentions both indirectly and directly over time.

We combined these direct measures with detailed measures that specify (1) type of intention (i.e., intention to forego or postpone, or indecision), (2) the intended timing of a future pregnancy (if intended), and (3) indecision (i.e., whether women are undecided about whether and/or when to have a(another) child). The combination of direct measures of perceptions of changes in intentions because of Covid and measures that distinguish between foregoing, postponing, and indecision capture temporal granularity of an intended pregnancy and are critical for understanding the nuanced ways in which the pandemic might shift fertility intentions among women generally, and also differentially by socioeconomic and demographic characteristics. For example, in making the distinction between intentions to forego, postpone, and indecision, our questions account for the different ways in which structural shocks can shape fertility are distinct phenomena that can be measured through surveys (Hayford and Agadjanian 2019; Timæus and Moultrie 2008) and that are sensitive to macrostructural crises such as the Covid-19 pandemic.

Study Overview

Between May and September 2020, the DeCodE project conducted 25-minute phone interviews² with women aged 18–34 in the state of Pernambuco, Brazil. A coastal state in the country's northwestern region, Pernambuco was severely impacted by the 2015–2017 Zika epidemic and by the Covid-19 pandemic. Pernambuco is also highly unequal and reflects Brazil's diverse population in terms of socioeconomic status (SES) and race/ethnic variation. Despite persistent inequality and poverty, as well as a low human development index (Instituto Brasileiro de Geografia e Estatística 2017), the fertility rate has declined significantly in the last decades in Pernambuco, reaching below-replacement levels (1.67) (Instituto Brasileiro de Geografia e Estatística 2019), following the country's overall patterns. This combination of socioeconomic, demographic, and public health factors makes Pernambuco an important place to examine fertility intentions amid the Covid-19 pandemic.

We recruited respondents using a random digit dialing technique, and interviews were conducted with computer-assisted telephone interviews. We used a list of randomly generated cell phone numbers from Brazil's government concession of cell phones, drawing from a sampling base of more than 19 million numbers.³ Research from Brazil's Census Bureau (Instituto Brasileiro de Geografia e Estatística 2021) shows that 94 percent and 88 percent

² We used a hybrid model of data collection in which the DeCodE team conducted data quality checks and interviewer training independently from the survey firm. The DeCodE team comprised of a locally based field supervisor and two interviewers to maintain contact with respondents and update their contact information.

³ We used a dual frame sample design, with 70 percent of the sample selected through a list-assisted random-digit dialing (RDD) procedure and 30 percent selected at random from a commercial database. In the RDD frame, we used the available 1,000 banks dedicated to cell phones in the target area code 81, as informed by the telecommunications authority in Brazil. We then stratified these numbers into three strata. The first two strata were based on region (stratum 1: metropolitan region of Recife; stratum 2: nonmetropolitan region of Recife) using the location of the plurality of the listed phones, while the third stratum contained those for whom the 1,000 banks did not have any listed number. The sample was allocated proportionately to the number of 1,000 banks from each stratum. Within strata 1 and 2, the 1,000 banks were selected with probabilities proportionate to the number of listed cell phones, and within stratum 3, they were selected at random. All numbers were sampled from the selected 1,000 banks for a total of approximately 3,000,000 cell phone numbers. More details of the sampling and study procedures available from authors.

of women in this age group own a cell phone in the metropolitan region of Recife, and Pernambuco state, respectively, highlighting the large reach of our sampling base. Following the American Association for Public Opinion Research's guidelines, the baseline cooperation rate is 68.94 percent (The American Association for Public Opinion Research 2016; Kennedy and Hartig 2019).

The first wave survey included questions about current and prospective reproductive behaviors and intentions, Zika, and Covid-19. The second wave of data collection took place between May and August 2021.⁴ We followed respondents through a hierarchical mixed-mode data collection process that included phone, web, Whatsapp messages, and household visits (following Covid-19 protocol). This protocol ensured that respondents who moved out of their baseline municipality or out of their household had an equal chance of being contacted as respondents who did not move. This mixed-mode protocol also ensured that respondents who changed their cell phone numbers could also be contacted. Overall, wave 2 response rate was 66 percent.

The principal investigator of the study was involved in all steps of the data collection process, along with a team of researchers based in Brazil and the United States. The research was approved by the institutional review board (IRB) at the University of Texas at Austin and the Brazilian National Commission for Research Ethics (Comissão Nacional de Ética em Pesquisa). Interviewers received verbal consent by reading an IRB-approved script.

Analytical Sample

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This study's first analytical sample includes respondents who were not sterilized or declared infecund at wave 1 (N=3,753) living in 94 municipalities. The second analytical sample includes respondents who were successfully followed up in wave 2 and who were not sterilized or infecund (N=2,448). Table 1 describes the sample characteristics of respondents by the wave.

Cross-sectional analysis of waves uses raked weights that adjust for unequal selection probabilities, to integrate samples, and for nonresponse and coverage adjustments. We constructed raked weights with a three-step process (Deville and Särndal, 1992; Valliant, Dever, and Kreuter 2013). First, we assigned each respondent a weight that was the inverse probability of selection from the telephone bank (i.e., the sampling base). Second, we adjusted weights to account for nonresponse. Finally, we calibrated weights so that our sample distribution matched the population distribution of Pernambuco with respect to age, race, education, and urbanicity of the municipality of residence. When using wave 2 analytical sample, raked weights also adjust for attrition.

Measures

Here, we provide a brief description of the questions we used to construct our fertility intention measures at baseline (for exact questionnaire wording in English, see the Appendix). We then discuss the utility of these measures by highlighting insights gleaned from them in the sections that follow.

⁴ We conducted additional interview checks (n=230) between September and December 2021.

TABLE 1	Sample characteristics. DeCodE wave	1 and wave 2 respondents
INDLLI	Sample characteristics, Decoul wave	1 and wave 2 respondents

Characteristics at wave 1	Wave 1, % ^a	Wave 2, % ^a
Age		
18-26 years	55.4	53.4
27-34 years	44.6	46.6
Race		
Non-White	69.2	67.4
White	30.9	32.6
Social origin (maternal education)		
Less than high school	58.2	58.7
High school or more	41.8	41.3
Marital status		
Married	26.1	26.7
Not married	73.9	73.3
Parity		
None	52.7	52.3
One	26.9	28.6
Two or more	20.4	19.1
Fertility intentions using DeCodE survey design		
Intends in six months but would consider postponing due to Covid	1.8	1.0
Intends in six months and would not postpone	1.5	2.1
Intends in 7–23 months, postponed due to Covid	4.3	3.4
Intends in 7–23 months, postponed for other reasons	8.5	8.5
Intends after two years or more, postponed due to Covid	8.2	9.5
Intends after two years or more, postponed for other reasons	24.0	23.2
Intends, unsure timing due to Covid	3.9	4.5
Intends, unsure timing for other reasons	12.5	14.0
Foregone due to Covid	6.4	5.2
Foregone for other reasons	25.4	25.6
Undecided due to Covid	0.8	0.7
Undecided for other reasons	2.8	2.4
Unweighted N	3,753	2,448

^a Percentages are within wave 1 and wave 2 subsamples, that is, column percentages.

We began by asking respondents whether they intended to have a(nother) child in the future (Figure 1). For those who intended to have (more) children in the future (Flow 1), we asked what their intended timing was. For respondents who wanted a child within the next six months, we asked whether they would consider postponing their intended pregnancy due to Covid-19. For those who reported intending a pregnancy after six months, we asked whether they were postponing their intended pregnancy because of the pandemic. In the wave 2 questionnaire (not in Figure 1), we expanded to all respondents who wanted a child, regardless of timing, a question about whether and how their intended timing of pregnancy was influenced by Covid-19.

For respondents who wanted a(nother) child but did not know when, we asked whether their (un)surety regarding timing was because of Covid-19. For those who wanted to forego childbearing altogether (Flow 2), we asked whether they changed their intention to have a child because of Covid-19. Finally, for respondents undecided about whether to have a(nother) child (Flow 3), we asked whether this indecision was because of Covid-19. As noted in the Appendix, and following standard practice, questionnaire wording on fertility intentions was different for respondents who were pregnant at the time of the interview; for pregnant women, we asked whether and how soon after giving birth they intended to have a child again.

To clarify, while our survey design captures whether respondents attributed the change in their intentions to Covid versus other reasons, we did not specify "other reasons" for changing



FIGURE 1 Flow chart for construction of fertility intentions typology using DeCodE, Wave 1

NOTE: Target sample for questions on fertility intentions is women, ages 18-34, who were not sterilized or declared infecund (N=3,753).

Timing regarding when to have another child refers to the duration within which the respondent intends to get pregnant. Among currently pregnant respondents, timing refers to how soon after giving birth the respondent would like to pregnant again.

intentions with this direct question. However, because the survey includes information on the socioeconomic, health, and relationship status of respondents in each wave (e.g., selfreported health and health care status, income group, education, and relationship status), the data can tap into potential other reasons through an analysis of cross-sectional variation or panel change into how individual conditions are associated with reported intentions (though this is beyond the scope of this paper).

Analytical Methods

We divide our primary analysis into two broad sections: a cross-sectional analysis of wave 1 data and a longitudinal analysis of panel data. We begin our cross-sectional analysis by describing participants' fertility intentions using conventional classifications and our DeCodE classification, thus comparing these measures and highlighting the added detail gained from a granular and direct indicator underscoring perceptions of change during the emerging months of the Covid crisis (Table 2).

We next examine wave 1 fertility intentions by social origin and parity, using Pearson chi-square tests of proportions to determine if fertility intentions differ by these characteristics (Table 3). Social origin is proxied by the mother's education (less than high school vs.

Fertility intentions using			Col % within each conventional classification
conventional classification	Col. %	Subcategories identified with DeCodE survey design	category
Intends a(nother) child in two years	16.1	Intends in six months but would consider postponing due to Covid	11.2
		Intends in six months and would not postpone	9.5
		Intends in 7–23 months, postponed due to Covid	26.5
		Intends in 7–23 months, postponed for other reasons	52.7
			100.0
Intends after two years or	32.1	Intends after two years or more, postponed due to Covid	25.5
more		Intends after two years or more, postponed for other reasons	74.5
			100.0
Intends; unsure timing	16.5	Intends, unsure timing due to Covid	23.9
c		Intends, unsure timing for other reasons	76.1
		C C	100.0
Foregone	31.7	Foregone due to Covid	20.0
0		Foregone for other reasons	80.0
		-	100.0
Undecided about a(nother)	3.6	Undecided due to Covid	23.1
child		Undecided for other reasons	72.6
			100.0
Total	100.0		

TABLE 2Women's fertility intentions using conventional versus detailed DeCodEclassification, wave 1 respondents (N=3,753)

completed high school diploma or more) and parity is grouped into 0, 1, versus 2 or more children.

Specifically, we implement Pearson chi-square independence tests to examine whether the proportion of respondents in each fertility intention category (rows) is significantly different across social origin groups and parity groups (columns). We first provide results of tests examining differences across social origin groups and parity groups for each fertility intention category separately. We then collapse respondents into two broader fertility intention categories and calculate additional tests comparing respondents across social origin groups and parity groups for: (1) those who reported *any* kind of change in fertility intentions specifically due to Covid-19 (postponed or would consider postponing due to Covid, foregone due to Covid, unsure about timing due to Covid, or unsure about intending due to Covid) and (2) those who changed their intended *timing* of childbearing due to Covid (postponed or would consider postponing due to Covid, or are unsure about timing due to Covid, or are unsure about timing due to Covid).

We next track changes in fertility intentions across the Covid pandemic using two waves of survey data (Table 4). We then further examine temporal change using our granular measures of fertility intentions, as well as indicators of change in intentions specifically due to Covid (Table 5). The sum of these analyses will provide cross-sectional and longitudinal descriptions of a nuanced typology of fertility intentions in the context of a massive public health crisis.

	Social origin (ma	ternal education)		Parity	
	Less than high school	High school or more	None	One	Two or more
Granular measure of fertility intentions					
Intends a(nother) child in six months					
1) Consider postponing due to Covid	1.5	2.3	0.9	3.8	1.6
2) Would not postpone	1.8	1.3	1.4	1.7	1.6
Intends a(nother) child in 7–23 months					
3) Postponed due to Covid	5.1	3.6	5.3	3.8	2.4
4) Postponed for other reasons	7.3	10.4	12.3	4.6 ^b	4.6 ^b
Intends a(nother) child after two years or more					
5) Postponed due to Covid	9.4	6.8	8.2	12.3	3.0 ^{b,c}
6) Postponed for other reasons	22.2	28.6 ^a	33.5	20.4 ^b	5.5 ^{b,c}
Intends a(nother) child but unsure of timing		2010	0010	2011	010
7) Unsure due to Covid	4.4	2.4	2.7	8.4 ^b	1.9 ^c
8) Unsure due to other reasons Foregone	9.9	14.5	19.8	5.7 ^b	2.1 ^{b,c}
9) Foregone due to Covid	8.2	2.7 ^a	1.5	7.2 ^b	18.3 ^{b,c}
10) Foregone for other reasons Undecided about a(nother) child	27.6	21.8 ^a	10.2	28.9 ^b	56.8 ^{b,c}
11) Undecided due to Covid	0.6	1.4	0.7	1.7	0.3
12) Undecided for other reasons	1.8	4.2	3.5	1.5	1.8
Total	100.0	100.0	100.0	100.0	100.0
13) Fertility intentions affected by Covid (sum of rows 1, 3, 5, 7, 9, and 11)	29.2	19.2 ^a	19.3	37.2 ^b	27.5 ^b
14) Fertility timing affected by Covid (sum of rows 1, 3, 5, and 7)	20.4	15.1	17.1	28.3 ^b	8.9 ^{b,c}

TABLE 3Women's fertility intentions by socioeconomic and demographic characteristics,DeCodE wave 1 respondents (N=3,753)

NOTES: Pearson chi-2 tests of independence are used to examine if % of respondents in each granular fertility intention category (rows 1–12) and each collapsed category (rows 13 and 14) is significantly different across social origin groups and parity groups (columns). Significance levels set at 5% or lower.

^a Denotes significant difference compared to women with low social origin status (mother's education = less than high school).

^bDenotes significant difference compared to women with no children.

Denotes significant difference compared to women with one child.

RESULTS

Aim 1: The Value of Differentiating Foregoing and Postponing

Table 2 demonstrates the value added by using a direct measure of perceptions of change in fertility intentions measured cross-sectionally due to the pandemic combined with differentiating foregoing and postponing. Within each type of intention, roughly one-fifth to one-quarter of women attribute their intention as having changed due to the Covid-19 pandemic. For example, using the conventional classification, we find that approximately 31.7 percent of the women in wave 1 reported not intending another child, that is, foregoing childbearing. Our direct measure about whether women changed their minds because of Covid-19 reveals that among women who reported not intending a(nother) child, one-fifth attribute their intention to forego (additional) children as due to the Covid-19 pandemic. Of women who intend a(nother) child in the next two years, 37.8 percent postponed or would consider postponing due to the pandemic. Among women who intend another child after two years from the time of the interview, 25.5 percent reported that they postponed their

		Fertility	intentions, wave 1		
Fertility intentions, wave 2 (Col %)	Intends a(nother) child in two years	Intends a(nother) child after two years or more	Intends; unsure timing	Foregone	Undecided about a(nother) child
Intends a(nother) child in two years	16.4	75.0	15.6	9.1	15.6
Intends a(nother) child after two years or more	57.2	7.5	58.4	1.9	23.2
Intends; unsure timing	0.5	2.2	5.4	0.9	0.0
Foregone	24.8	12.3	15.5	85.3	40.7
Undecided about a(nother) child	1.1	3.1	5.2	2.8	20.4
Total	100.0	100.0	100.0	100.0	100.0
Unweighted N	367	899	296	793	93

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pregnancy plans due to the pandemic. Reporting these percentages gives a sense of both the magnitude and the varied ways in which women have altered their childbearing intentions in response to the pandemic.

We also considered *indecision* about future childbearing and the timing of childbearing. Rather than conceptualizing "undecided" responses as a residual category, we treated them as a meaningful substantive category that captures indecision about the timing of childbearing during an extremely volatile period. The uncertainty around the severity and consequences of the pandemic, particularly early on, might be linked to indecision around fertility intentions, and thus, this statistic is in itself informative. Among the 3.6 percent of women who reported being undecided about having a(nother) child, 23.1 percent attribute their indecision to the pandemic. Additionally, a nontrivial proportion of women (16.5 percent) were unsure about the timing of an intended pregnancy and approximately a quarter of them indicated that this unsurety was because of the pandemic (23.9 percent).

Aim 2: Window Shorter Than Two Years in Intended Timing

Most studies examining fertility intentions distinguish between people who intend to become pregnant within two years and people who intend to become pregnant after two years (Croft et al. 2018). By grouping women who intend children within the next two years into one category, this classification treats women who intend children in the immediate future (e.g., next six months) and women who intend to postpone childbearing by six months to two years as identical. As such, these standard measures do not capture how sudden disruptions from a structural crisis shape short-term postponement intentions. We propose a process to parse these groups, and analyze if women are incorporating short-term (or long-term) changes to their original timelines during a macrostructural crisis. We demonstrate that indicators of shorter windows for fertility intention classification are advantageous for studying shifting childbearing preferences during periods of crises such as the Covid-19 pandemic.

Table 2 also highlights added detail gained from this granular measure in comparison with the conventional classification. At wave 1, 64.7 percent of the respondents intended to have children sometime in the future, and of these, nearly a quarter intended to get pregnant within the next two years. Among those who wanted to get pregnant within the next

1	-	\mathbf{n}
1	.7	4

			Fertility intenti	ons at wave 1		
- Fortility intentions of ways 2	Intended a child within two years	Intended a child after two years or	Intended a child but unsure timing	Foregone due to Covid	Foregone for other	Undecided about
1) Intends s(nother) child in six months advanced	10	010	9	00	01	
b) mitches a mouter / chine in six mounts, auvanced b/w waves due to Covid	0.11	1'0	T'O	0.0	1.0	0.0
2) Intends a(nother) child in six months,	2.9	2.0	9.4	0.8	0.0	0.6
2) Intendent b/w waves due to Covid	10	00	C 0	7	00	00
affected timing but unsure how	1.0	0.0	7.0	F-11	0.0	0.0
4) Intends a(nother) child in six months, Covid	4.6	2.3	3.5	0.0	1.1	7.8
did not attect timing 5) Intends a(nother) child in 7–23 months,	0.9	0.3	0.0	0.0	0.0	0.0
advanced b/w waves due to Covid 6) Intends a(nother) child in 7–23 months,	2.5	1.3	6.0	0.0	0.1	0.5
postponed b/w waves due to Covid 7) Intends a(nother) child in 7–23 months. Covid	0.0	0.0	0.0	0.0	0.0	0.0
affected timing but unsure how 8) Intends a(nother) child in 7–23 months. Covid	4.3	1.4	1.7	0.0	0.5	6.8
did not affect timing	0	6		200		
advanced b/w waves due to Covid	0.0	7.0	0.0	0.4	0.0	0.0
10) Intends a(nother) child after two years or	13.4	20.1	9.7	5.6	3.1	9.2
more, postponed b/w waves due to Covid 11) Intends a(nother) child after two years or	0.7	0.1	0.0	0.1	0.0	0.0
more, Covid affected timing but unsure how 12) Intends a(nother) child affer two vears or	40.1	51.6	48.6	4.5	5.7	14.0
more, Covid did not affect timing				2		
13) Intends but unsure timing, timing affected b/w waves due to Covid	0.0	0.2	2.2	0.0	0.1	0.0
14) Intends but unsure timing, Covid did not	0.5	1.9	3.1	0.9	0.8	0.0
affect timing 15) Foregone due to Covid	2.4	4.2	3.2	42.9	13.2	9.6
16) Foregone but not due to Covid	22.4	8.1	12.3	42.1	72.2	31.1
17) Undecided about a(nother) child due to Covid	0.5	1.3	3.0	0.0	1.9	16.6
18) Undecided about a(nother) child but not due	0.6	1.8	2.1	1.3	1.2	3.8
IO COVIA Total	100.0	100.0	100.0	100.0	100.0	100.0
Changed timing or intent to have (more)	27.5	32.9	28.7	51.2	18.5	36.5
7 , 9, 10, 11, 13, 15, and 17)	367	800	966	137	199	03
	100		0/1	777	100	Ŷ

two years, approximately 20.0 percent intended a pregnancy within the next six months, although half of them would consider postponing their plans because of Covid-19 (11.2 percent). Equally important, around a quarter of the women who intended to get pregnant within the next two years self-reported a postponement from previous plans because of Covid-19 (26.5 percent). Overall, slightly more than a third of the women who intended to get pregnant within the next two years of the baseline reported that they changed or would change their intended timing because of Covid-19 (37.8 percent). It is important to note that there is a great deal of variation within this group, both in terms of the intended timing of childbearing and on whether women considered Covid-19 as the main reason for changing.

There is a similar breakdown among respondents who intended a pregnancy after two or more years; in this group, a quarter noted that they have postponed a pregnancy because of Covid-19 (25.5 percent). The proportion of respondents who intended to postpone pregnancy because of Covid-19 increased when we considered only women in a marital union (26.1 percent; figures not shown in tables), highlighting the significance of the pandemic for the intentions of women at the most risk of childbearing. For example, the proportion of respondents who intended a(nother) child in the future is 55.3 percent if we consider only women in marital unions. Among women in marital unions who intended to have a(nother) child in the future, 38.4 percent reported that Covid-19 affected their intended timing of childbearing (i.e., postponed by more than six months, considering postponing or unsure regarding timing because of Covid).

There is also important detail gained from examining the nuanced intentions of women in marital unions within the next two years of the baseline. With the standard-type classification, we would identify that 15.4 percent of married women intended children within the next two years. However, upon further categorization, we find that around half of them would consider (18.6 percent) or have postponed (36.4 percent) childbearing to after six months explicitly because of the pandemic (total of 55.0 percent). This underscores how Covid-related disruptions have generated a flux in fertility intentions, particularly for women who are at a life course stage where childbearing is more common.

Aim 3: Variations in Fertility Intentions

We first provide evidence of flexibility in fertility intentions because of Covid-19 by social and economic characteristics to underscore the value of direct and more granular fertility measures. We focus on comparisons across social origin proxied by mother's education, and by parity. Our granular measures reveal, in greater detail, how changes in fertility intentions are stratified. With standard measures, we would not see all the varied ways in which different groups respond to the pandemic.

Overall, findings from Table 3 suggest that there is significant variation in fertility intentions by social origin and parity. A larger proportion of low SES women (29.2 percent) than high SES women (19.2 percent) reported that their fertility intentions were affected by Covid. Compared to their more privileged counterparts, women with low SES were more likely to report that they intended to forego childbearing because of Covid (8.2 percent vs. 2.7 percent).

Turning to parity, we find that a larger proportion of mothers (37.2 percent for those with one child and 27.5 percent for those with 2+ children) than nonmothers (19.3 percent) attributed flexibility in fertility intentions to Covid. A closer look reveals important distinctions in the type of intention flexibility by parity levels, underscoring the importance of considering this life course stage in such analysis. Mothers, especially those with two or more children, were more likely to report that they forwent childbearing due to Covid (7.2 percent for those with one child and 18.3 percent for those with 2+ children) than nonmothers (1.5 percent). Mothers with one child were also more likely to attribute changes in the timing of intended childbearing plans to Covid than nonmothers (28.3 percent vs. 17.1 percent). In contrast, mothers who had two or more children were the least likely to attribute changes to intended fertility timelines to Covid (8.9 percent).

We complement these descriptive results with multivariate logistic regressions to identify the subgroups of women who were most likely to report that their fertility intentions were affected by the Covid net of covariates. For our outcome variable, we use the collapsed measure indicating whether respondents reported any kind of change in fertility intentions due to Covid-19. We model this binary outcome as a function of the respondent's age, race, marital status, mother's education, and parity. The results, presented in Appendix Table A2, suggest that women with low SES and women with one child (vs. no children) were more likely to report that their intentions were affected by Covid, controlling for age, race, and marital status.

The social origin and parity patterns in fertility intentions at wave 2 are largely consistent with the patterns observed at wave 1 described above (available upon request). One important addition to our fertility intentions measures in wave 2 is a measure of advancement intentions; that is, we asked respondents whether they intended to get pregnant sooner than previously intended due to the Covid-19 pandemic. We do not observe any notable patterns in the advancement of childbearing plans between waves due to Covid.

Our next set of results illustrate the variation in fertility intentions longitudinally. In addition to asking about self-reported changes in fertility intentions and implementing a more granular window of timing using a cross-sectional approach, the DeCodE panel data structure study allows for tracking changes in respondents' fertility intentions throughout the pandemic, across annual waves. Panel surveys are expensive and time-consuming and are, therefore, less common than cross-sectional surveys, particularly in low- and middle-income countries. Nonetheless, we report longitudinal changes in fertility intentions in the DeCodE study to inform other panel survey administration efforts, and also because they have implications for indicators of fertility intentions in cross-sectional surveys. Assessing stability and change longitudinally can help researchers design research-informed retrospective questions that can be used in cross-sectional surveys as another way to measure change.

This design in tandem with our fertility intention measures sheds new insight on how childbearing preferences have shifted across the Covid-19 pandemic. First, we examine self-reported indicators at two points during the pandemic—at the onset of Covid-19, using data from wave 1, and then a year later, using data from wave 2, as discussed above. Next, we highlight fertility intention measures that exploit the panel structure of our data.

Table 4 displays changes in fertility intentions across waves. Overall, findings highlight the high level of volatility in fertility intentions across waves in tandem with the intensification of the pandemic. For example, of the 367 respondents intending to have a(nother) child *within* two years of wave 1, the majority (57.2 percent) reported intending to have a(nother) child *after* two years in wave 2. Another 24.8 percent of those who intended to have a(nother) child within two years at wave 1 reported that they intended to forego childbearing altogether in wave 2. Equally important, nearly half of the respondents who were undecided about a(nother) child in wave 1 reported in wave 2 that they intended to forego childbearing altogether (40.7 percent). Next, we consider a more nuanced time window to further illuminate the value of our granular measure of fertility intentions combined with a longitudinal strategy.

Table 5 displays respondents' fertility intentions at wave 2 based on reported intentions at wave 1. Specifically, it shows intention change across waves for those who, at wave 1 (1) intended a child within two years; (2) intended a child after two years or more; (3) intended a child but were unsure of the timing; (4) did not intend (more) children due to Covid; (5) did not intend (more) children for other reasons; and (6) were undecided about (more) children.

Generally, respondents' intention to have a(nother) child was stable across waves, although flexibility level varied by baseline fertility intention status. Among respondents who intended a(nother) child within two years of baseline, for example, approximately 75 percent still intended a(nother) child at wave 2, whereas the remaining 20 percent changed their fertility intentions, mostly foregoing pregnancy due to reasons other than Covid-19. Respondents who forwent childbearing for non-Covid reasons at baseline were similarly consistent in their fertility intentions. In this group, about 72 percent again reported intending to forego pregnancy for non-Covid reasons.

In contrast, fertility intentions were less stable among respondents who reported that they forwent pregnancy due to Covid-19 at baseline or who were undecided at baseline. Among those who initially reported foregoing pregnancy due to Covid-19 at baseline, 42.9 percent did not change their intention, but 42.1 percent reported foregoing due to non-Covid reasons at wave 2. Similarly, among those who were undecided at baseline, 20.4 percent remained undecided, 38.9 percent reported intending a(nother) child, and 31.1 percent reported foregoing pregnancy for non-Covid reasons.

While flexibility in fertility intent across waves was relatively stable, flexibility in intended timing was dynamic, constituting an important aspect of fertility intentions during the pandemic. This further underscores the importance of considering a window timing shorter than 2 years in tandem with intentions to postpone or forego. Of the women who intended a(nother) child within two years of the baseline, 16.3 percent remained with the same intended timing, while 57.2 percent intended a(nother) child after two years of wave 2. Equally important, another 24.8 percent reported in wave 2 the intention to forego childbearing altogether.

We further shed light on the importance of differentiating intentions to postpone versus forego when examining fertility avoidance change during the pandemic. Table 5 shows that, overall, 27.5 percent of the women who intended childbearing within two years of the baseline reported that they changed their intent or timing explicitly because of Covid-19. Of these women, 18.8 percent intended a child at wave 2 and reported that they had postponed childbearing between waves, and 2.4 percent intended to forego childbearing altogether in wave 2 due to Covid. Another key finding is that very few women reported intentions to advance pregnancy timing between waves due to Covid-19 (\sim 5.0 percent of those who intended a child within two years at wave 1) suggesting that, as the pandemic intensified, women intended to avoid rather than advance childbearing. Combined, these findings suggest the value of differentiating changes in pregnancy avoidance intentions by postponement and foregoing during periods of structural uncertainty.

It is also worth noting that a sizeable proportion of the respondents also continued intending a(nother) child after two years, so Covid-19 did not affect their intended timing. Nearly, 52 percent of the panel respondents who reported intending a child after two years at baseline reported consistency in intending a child after two years at wave 2, noting that Covid did not affect the timing of their intended childbearing in the interval. Unsurprisingly, the majority of these respondents are young (64.4 percent are 18–26 years vs. 35.6 percent are 27–34 years at wave 1) and unmarried (76.2 percent are not married vs. 23.8 percent are married at wave 1), which highlights the important ways in which fertility intentions in times of crises are patterned by life course stages.

DISCUSSION

In this paper, we proposed measures that capture change in fertility intentions that are especially useful during periods of structural uncertainty. Our study makes three key contributions to the conceptualization and construct of fertility intention measurement: First, we demonstrate the value of including a direct measure of fertility intention change that links individual-level fertility intentions to a macro-level crisis, in addition to indirect measures that capture change longitudinally. Second, we demonstrate the importance of a granular typology that underscores differences in intention to postpone versus forego, rather than combining fertility avoidance, and also examines indecision. Third, we show the relevance of measures of fertility intentions that reflect a granular time window within two years, documenting variation cross-sectionally and longitudinally.

Capturing fertility intentions at the onset of the pandemic meant that respondents had to consider their fertility intentions in an ever-shifting context where knowledge about Covid-19 and SARS-CoV-2 was very limited but rapidly evolving. Early in the pandemic, both its severity and length were unclear, which in turn directly influenced our survey design. We opted to implement a comprehensive approach that included a combination of direct and indirect measures of (change) in fertility intentions. Specifically, we proposed that changes in fertility intentions in response to a structural shock require a set of indicators to capture both how women perceive the direct impact of the crisis on their fertility intentions and the nuanced/indirect ways in which the shock might affect their intentions, which can only be measured prospectively. We argue that these direct and indirect measures complement each other in that both measures capture the flux in women's reproductive intentions in response to the shock.

Our approach also included a combination of cross-sectional and longitudinal measures. With this exercise, we show that it is possible and useful to capture change in intentions cross-sectionally using retrospective measures. This is an important application, especially for research in low- and middle-income countries where it can be difficult to implement probabilistic panel data studies. As we demonstrated, the DeCodE survey's cross-sectional data structure offers critical knowledge for understanding fertility intentions early on and over the course of the pandemic. This is in line with evidence showing that retrospective indicators can be efficient in measuring fertility intentions and are not necessarily problematic (Yeatman and Sennott 2015). Our measures extend this by demonstrating the value of considering the dynamic nature of fertility intentions even when implemented cross-sectionally during periods of considerable structural change.

The second contribution of our measures of fertility intentions is that they allow for differentiating childbearing avoidance between the intention to postpone versus the intention to forego childbearing altogether. Rather than combining fertility avoidance into a single group, we differentiate foregoing and postponing while also using a direct measure of self-perception of change in fertility intentions due to the pandemic. We find important socioeconomic and demographic differences within the group of women who intended to avoid childbearing when examining foregoing versus postponing that would have otherwise been masked. Similarly, we also find value in considering foregoing versus postponement in considering selfreported changes in intentions due to the pandemic even cross-sectionally.

Our measures are richer also by treating indecision as a meaningful category that captures uncertainty about childbearing intention and its timing during an extremely volatile period. We contend that the dramatic uncertainty around the severity and consequences of the pandemic, particularly early on, might be linked to indecision around fertility intentions. Combined, a considerable proportion of women who reported indecision regarding whether or when to intend childbearing also reported that this indecision was because of the pandemic. This is an important finding, particularly in light of research that has shown how fertility ambivalence is associated with unintended pregnancy, and that women experiencing a high quality of care are more prone to reporting less ambivalence on fertility intentions (Wekesa, Askew, and Abuya, 2018). The next important step to further uncover indecision and uncertainty in fertility intentions during the pandemic is to examine how confident women felt about being able to match their fertility intentions with their fertility outcomes during the pandemic. Increases in respondent's uncertainty in matching intention and outcome have been found in periods of increasing economic uncertainty in European countries, for example (Fahlén and Oláh 2018). It is possible that there is a similar increase in women's perception of uncertainty in matching fertility intention to the outcome when tracking the dynamic flux of fertility intentions throughout the Covid-19 pandemic.

Our third contribution is to show that there is a great deal of nuance when we consider fertility intentions within a two-year window of time that is missed when combining this category. We show, for example, that there is a nontrivial proportion of women who reported intending childbearing within two years, and a great deal of variation in how this group of women reported that the pandemic had affected their fertility intentions. Within this group, we also find significant variation by social origin and parity that merit further understanding. We argue that, given the extreme uncertainty regarding infection, transmission, and consequences of Covid-19 early on, particularly the lack of knowledge regarding its consequences for pregnant people and their babies, it becomes ever-important to consider measures of fertility intentions within a time period shorter than two years. It is likely that circumstances 17254465, 2023, 1, Downloaded from https://oninelibrary.wiley.com/doi/10.1111/sitp.12219 by University Of Texas Libraries, Wiley Online Library on [2203/2023]. See the Terms and Conditions (https://oninelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA anticles are governed by the applicable Crative Commons Licenses.

other than the pandemic also require such a level of nuance in examining fertility intentions and their timing.

While this study contributes to the literature on fertility intention change, it has some important limitations. This study is based in a country and state heavily hit by the Zika epidemic that ended three years prior to the emergence of the Covid-19 pandemic. Because Zika, in particular, is associated with fetal malformation, it is possible that this population has experienced the pandemic in different ways because of this recent experience which would, in turn, make this study's findings less generalizable.

At the same time, Zika has touched the entire country and all of the Americas. Further, given the persistent emergence and re-emergence of novel infectious disease epidemics globally, these crises have become and will continue to be more common. Importantly, this study's respondents live across 94 municipalities with varying Zika, microcephaly, and Covid-19 rates. To that end, there are differences in exposure to Zika (and Covid) at the individual and the municipality levels that ensure some degree of variation in women's experiences. Still, this is not a representative sample of the entire country, and, therefore, this study's findings are unique to this state population. Another limitation is that the study's age group does not comprise all women of childbearing ages.

As the pandemic persists and people adapt to Covid-19, its influence on fertility intentions and other fertility and health behaviors may wane or intensify, also depending on exposure at the individual-, meso-, and macro-levels. To that end, it is key to understand that, the overall "effect" of the pandemic on fertility intentions may depend on whether we examine behavioral responses or proximate determinants of fertility. Behavioral responses to Covid-19 are dependent on what people consider to be a Covid-related reason to change intended fertility. For example, concern that Covid may harm an infant *in utero* during pregnancy is almost certainly Covid-related. However, a respondent may choose to change an intended pregnancy due to job insecurity or income loss resulting from the pandemic. This may be reasonably interpreted as related or unrelated to Covid. As such, the next step to better understand the effects of the pandemic on fertility is to unpack what the pandemic means for people—for example, economic shock, health deterioration, increasing child care responsibilities, and risk perception. It is key to disentangle the mechanisms explaining changes in fertility intentions as the Covid-19 pandemic progressed and imposed an array of consequences on women's lives globally. The design of the DeCodE study, following women throughout the pandemic, allows for such refined explanations of mechanisms that define flexibility in fertility intentions.

DATA AVAILABILITY STATEMENT

Data for this study come from the Demographic Consequences of Zika and Covid project. Data are available upon request and under revision by the IRB. Data will become publicly available once all waves of data are collected.

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