

# Impact of the COVID-19 pandemic on the perception of planned oocyte cryopreservation in the United States

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**Objective:** To assess the impact of the COVID-19 pandemic on attitudes toward planned oocyte cryopreservation (OC).

**Design:** Cross-sectional study.

**Setting:** Internet-based survey questionnaire distributed nationally.

**Patient(s):** One thousand women aged 21–45 years, stratified by age  $\leq 35$  or  $>35$  years.

**Intervention(s):** None.

**Main Outcome Measure(s):** Change in the likelihood of considering OC because of the pandemic.

**Result(s):** Of the participants who reported that the pandemic altered their likelihood of considering OC (15.2%,  $n = 152$ ), 52.6% ( $n = 80$ ) reported an increased and 47.3% ( $n = 72$ ) reported a decreased likelihood of considering OC. Vaccination status did not affect the likelihood of considering OC. In multivariable analysis, history of COVID-19 infection (odds ratio [OR] 1.57; 95% confidence interval [CI] 1.00–2.45), government-subsidized insurance (OR 1.47; 95% CI 0.97–2.21), loss of health insurance because of the pandemic (OR 2.32; 95% CI 1.15–4.66), working more (OR 2.99; 95% CI 1.62–5.51) or less (OR 2.54; 95% CI 1.65–3.90) because of the pandemic, and relationship status (divorced, separated, or widowed [OR 0.44; 95% CI 0.20–0.99]) were significantly associated with a change in the likelihood of considering OC because of the pandemic. Of those who believed that the COVID-19 pandemic influenced their childbearing plans (28.3%,  $n = 283$ ), 64.0% ( $n = 181$ ) deferred childbearing and 29.7% ( $n = 84$ ) expedited childbearing. The pandemic's economic impact, concerns regarding safety of pregnancy/childbirth, and safety of childrearing were cited as most influential on childbearing (67%, 70%, 58%, respectively) and on the likelihood of considering OC (47%, 45%, and 34%, respectively).

**Conclusion(s):** Through its negative impact on financial security and perceived safety, the COVID-19 pandemic has altered the likelihood of considering OC in  $>15\%$  of reproductive-aged women and reproductive timelines in 30%. Vaccination has not significantly modified these changes. (Fertil Steril Rep® 2022;3:145–52. ©2022 by American Society for Reproductive Medicine.)

**Key Words:** COVID-19, coronavirus, pandemic, fertility preservation, oocyte cryopreservation

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The COVID-19 pandemic has profoundly impacted the lives of many Americans through changes in their physical and psychological health, employment, and social dynamics. Although reproductive planning is often influenced by many of these factors, data evaluating the

impact of the COVID-19 pandemic on reproductive decision-making are limited. Existing studies have suggested that approximately one-third of women have altered their childbearing or fertility treatment plans because of the COVID-19 pandemic (1–4). These reported changes are

predominantly characterized by a deferral of fertility, but some women have also reported a desire to expedite childbearing. In one national survey, 34% of women reported wanting to get pregnant later or have fewer children because of the pandemic, whereas 17% of women reported wanting to have a child sooner or have more children (2). Additionally, a recent study identified that of the nearly 30% of women who reported altering their fertility preferences because of the pandemic,  $\geq 60\%$  deferred conception, whereas nearly one-quarter attempted to conceive earlier than previously intended (3). 2021 survey results have suggested

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that the impact of the pandemic on fertility preferences has evolved over the course of the pandemic but remains pervasive (4).

The technological advances in fertility preservation over the past several decades have expanded the options for family planning. Specifically, oocyte cryopreservation, which was originally developed for use in women with impending ovarian failure because of disease or cytotoxic treatment, is now routinely offered in most fertility centers in the United States as a means of potentially preserving fertility in the setting of delayed childbearing and age-related fertility decline (5). Interest in this service was reported among 25% of reproductive-aged women in a 1000-person sample surveyed online in 2017 (6). Relationship status, employment status, and income have all been associated with an individual's likelihood of considering planned oocyte cryopreservation (OC) (6). Each of these variables has the potential to be impacted by the COVID-19 pandemic through the effects of social distancing on meeting a partner and maintaining relationships, increased unemployment and economic instability, and working remotely. Therefore, especially given the significant proportion of women altering childbearing plans because of the pandemic, it is reasonable to suspect that interest in OC may have been affected by the COVID-19 pandemic.

To our knowledge, no studies have evaluated the impact of the COVID-19 pandemic on the self-reported perception of OC. Additionally, the impact of COVID-19 vaccination on fertility preferences has not yet been explored. Therefore, the primary objective of this study was to assess if and how the COVID-19 pandemic altered a woman's likelihood of considering OC. Secondary objectives included the assessment of the overall likelihood of considering OC, if and how the COVID-19 pandemic altered a woman's decisions regarding childbearing, predictors of likelihood of considering OC or change in the likelihood of considering OC, and the impact of COVID-19 vaccination on these outcomes.

## MATERIALS AND METHODS

### Study Design

This cross-sectional study used an anonymous 82-item Internet-based questionnaire that was distributed nationally to reproductive-aged women. The participants voluntarily selected an online link that invited them to participate in the self-administered survey. An Institutional Review Board approval for this study was obtained at the University of Pennsylvania. The survey was administered between May 10, 2021, and May 20, 2021.

### Survey Platform

The participants were recruited from websites through the online research platform of Lab42. This market research firm was used due to its capacity to program and launch the survey instrument through secure links presented to participants using various social media sites, applications, mobile games, and loyalty reward sites, allowing for the collection of a sample representative of the targeted research population. The respondents were compensated for participating with credits

or points relevant to the website from which they accessed the survey link, and the process was completely opt-in without individual distribution of survey invites. The survey advertisement was nonspecific, but participants were made aware of the subject matter of the survey before initiating completion.

### Study Cohort

Individuals were included if they reported female sex, lived in the United States, and were aged between 21–45 years. The eligible participants completed an online consent form. Recruitment was designed to end once 1000 surveys were fully completed. The sample was stratified on the basis of age and parity. Specifically, 500 responses were obtained from participants aged 21–34 years, and 500 responses were obtained from those aged 35–45 years. In addition, within each age group, half of the responses were obtained from those who had at least one child and half from those who did not have any children but desired to have children in the future. A total of 5,355 individuals initiated the survey, and 4,355 were either disqualified based on exclusion criteria or terminated the survey before completion.

### Survey Instrument

The survey consisted of 5 parts assessing demographic information; reproductive health and fertility knowledge, specifically pertaining to age-related changes in fertility and miscarriage rates, as well as knowledge of the procedure, estimated cost, and estimated success of OC; reproductive preferences and factors that might influence decision-making and timing surrounding childbearing; willingness to consider and to pay for fertility preservation with OC; and the impact of the COVID-19 pandemic (Supplemental Table 1, available online). The impact of the COVID-19 pandemic was assessed via an inquiry of participants' perceptions of changes and infection history, vaccination status, and job structure modification because of the pandemic. The response categories for survey items relating to the likelihood of individual reproductive choices and the importance of individual factors on decision-making were measured using a 5-point Likert scale. For questions regarding the mechanisms through which the COVID-19 pandemic influenced reproductive decision-making, the respondents were allotted an unlimited number of selections. Otherwise, the participants were asked to select a single answer for each question. The survey was modified from the instrument used in the study by Milman et al. (6), which had been modeled from previously published survey instruments and was validated in terms of usability by an initial cohort.

### Statistical Analysis

Respondents' demographic characteristics were tabulated. The main outcome of interest was the proportion of the sample that believed that the COVID-19 pandemic influenced the likelihood of considering OC. Secondary objectives included the overall likelihood of considering OC, if and how the COVID-19 pandemic altered a woman's decisions regarding childbearing, predictors of likelihood of considering OC or change in the likelihood of considering OC, and the impact

of COVID-19 vaccination on these outcomes. Responses for likelihood to consider OC were measured using a 5-point Likert scale and then divided to create a dichotomous outcome, with those likely to consider OC defined as those who selected “extremely likely” or “likely” and those not likely to consider OC defined as those who selected “extremely unlikely,” “likely,” or “neutral.” Associations between individual variables and this dichotomous outcome or the primary outcome were assessed using Chi-square analyses. Multivariable logistic regression was used to evaluate predictors of both changes in the likelihood of considering OC because of COVID-19 and the overall likelihood of considering OC. The collinearity of variables was assessed with analysis of variance inflation factor (VIF), with VIF of  $>5$  considered significant (7). Within these analyses, employment status was defined as employed (full-time, part-time, and self-employed) or not currently employed (unemployed, homemaker, student, retired, and disabled). Employment status change because of the pandemic was defined as working more (becoming full-time or becoming employed) or working less (losing a job, going part-time, or becoming furloughed). Income was defined as  $< \$125,000$  and  $\geq \$125,000$ . All other variables were analyzed as categorized in Tables 1 and 2.

## RESULTS

### General Demographic Characteristics

The survey was completed by 1,000 participants. The demographic characteristics are listed in Table 1. As structured by survey dissemination parameters, 50% of the sample was aged  $< 35$  years and 50% was aged  $\geq 35$  years, with most of the sample (53.3%) aged 25–40 years.

### Demographic Characteristics Related to COVID-19

A history of COVID-19 infection in a family member or friend was reported by 59.5% ( $n = 595$ ) of participants, with 12.7% ( $n = 127$ ) of the cohort reporting a personal history of COVID-19 infection (Table 2). Of the sample, 28.6% ( $n = 286$ ) acknowledged interacting with COVID-19–positive individuals as part of their job, with 58.7% ( $n = 168$ ) of this subset considering themselves frontline workers. Employment status changes because of the pandemic were reported by 34.6% ( $n = 346$ ) of the participants, with 19.0% ( $n = 190$ ) of the total sample indicating loss of a job or being furloughed and 7.5% ( $n = 75$ ) of the total sample indicating new employment or a change to full-time status. Additionally, 27.1% ( $n = 271$ ) of the sample reported that they started working remotely more because of the pandemic, with nearly half of this subset completely working remotely. Although most participants did not experience a change in health insurance status, 5.8% ( $n = 58$ ) of the sample lost health insurance access and 4.8% ( $n = 48$ ) switched from private to government-subsidized health insurance because of the pandemic.

### Impact on OC

Among the respondents, 15.2% ( $n = 152$ ) believed that the COVID-19 pandemic influenced their likelihood of considering OC. Of this subset, 52.6% ( $n = 80$ ) reported that the

**TABLE 1**

#### Demographic characteristics of women surveyed.

Demographic characteristic	n (%)
Age, y	
21–24	133 (13.3)
25–29	200 (20.0)
30–34	167 (16.7)
35–40	333 (33.3)
41–45	167 (16.7)
Parity	
0 children	500 (50.0)
$\geq 1$ child	500 (50.0)
Ethnicity	
Hispanic	112 (11.2)
Race	
Caucasian or white	733 (73.3)
African American or black	121 (12.1)
Asian <sup>a</sup>	64 (6.4)
Other <sup>b</sup>	82 (8.2)
Sexual orientation	
Heterosexual	838 (83.8)
Bisexual	99 (9.9)
Homosexual	40 (4.0)
Other	23 (2.3)
Religion	
Catholicism	207 (20.7)
Non-Catholic Christian <sup>c</sup>	259 (25.9)
Judaism	14 (1.4)
Other <sup>d</sup>	161 (16.1)
No religious affiliation	359 (35.9)
Highest level of education completed	
High school degree or less	231 (23.1)
College degree or some college	653 (65.3)
Higher-education degree (Masters, Doctoral, or Professional)	116 (11.6)
Current employment status <sup>e</sup>	
Employed	616 (61.6)
Unemployed	127 (12.7)
Homemaker	185 (18.5)
Other	72 (7.2)
Type of medical insurance	
Private (Managed care plan [Health Maintenance Organization] or other)	497 (49.7)
Government-subsidized (Medicare or Medicaid)	363 (36.3)
No insurance	140 (14.0)
Annual household income (before taxes)	
$< \$25,000$	215 (21.5)
$\$25,000$ – $\$49,999$	300 (30.0)
$\$50,000$ – $\$74,999$	187 (18.7)
$\$75,000$ – $\$124,999$	179 (17.9)
$\geq \$125,000$	84 (8.4%)
Relationship status	
Single or dating	332 (33.2)
Living with significant other or engaged	215 (21.5)
Married/civil union/domestic partnership	377 (37.7)
Divorced/separated/widowed	76 (7.6)

<sup>a</sup> Also includes Southeast Asian/Pacific Islander (including the Indian subcontinent).

<sup>b</sup> Other includes American Indian or Alaska Native, Middle Eastern, other.

<sup>c</sup> Also includes Protestant and Greek Orthodox.

<sup>d</sup> Other also includes Buddhism, Hinduism, Islam.

<sup>e</sup> Employed includes full-time, part-time, self-employed; other includes student, retired, disabled.

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pandemic increased their likelihood of considering OC (18.4% [ $n = 28$ ] in the present and 34.2% [ $n = 52$ ] in the

TABLE 2

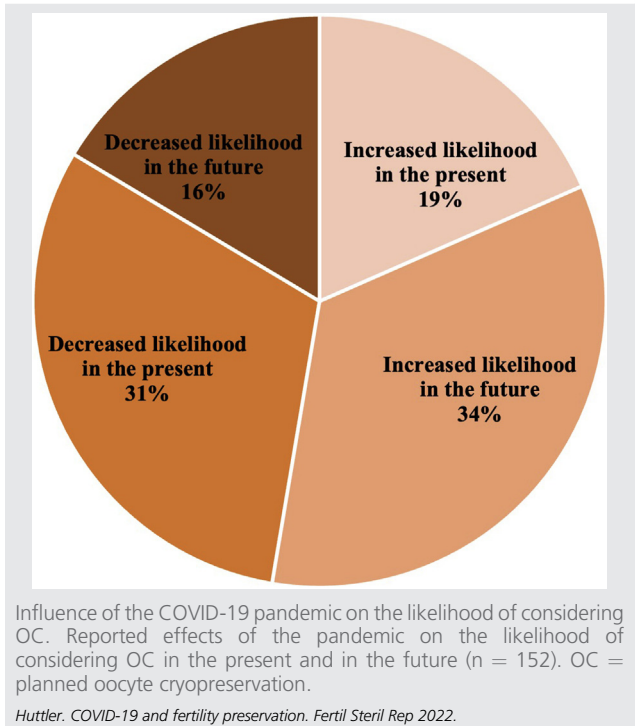
**Characteristics and demographic changes related to the COVID-19 pandemic.**

Characteristic	n (%)
Infection	
Self	127 (12.7)
Family/friends	595 (59.5)
Interaction with COVID-19–positive individuals at work	286 (28.6)
Employment status change because of the pandemic	
None	654 (65.4)
Lost job	139 (13.9)
Went part time	81 (8.1)
Furloughed	51 (5.1)
Went full time	38 (3.8)
Became employed	37 (3.7)
Amount of time working remotely <sup>a</sup>	
No change	394 (50.4)
More	271 (34.7)
Less	117 (15.0)
Health insurance change	
None	830 (83.0)
Lost insurance	58 (5.8)
Obtained insurance	55 (5.5)
Private to government-subsidized	48 (4.8)
Government-subsidized to government	9 (0.9)

<sup>a</sup> Percentages presented as a proportion of those to whom the question was applicable.

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FIGURE 1

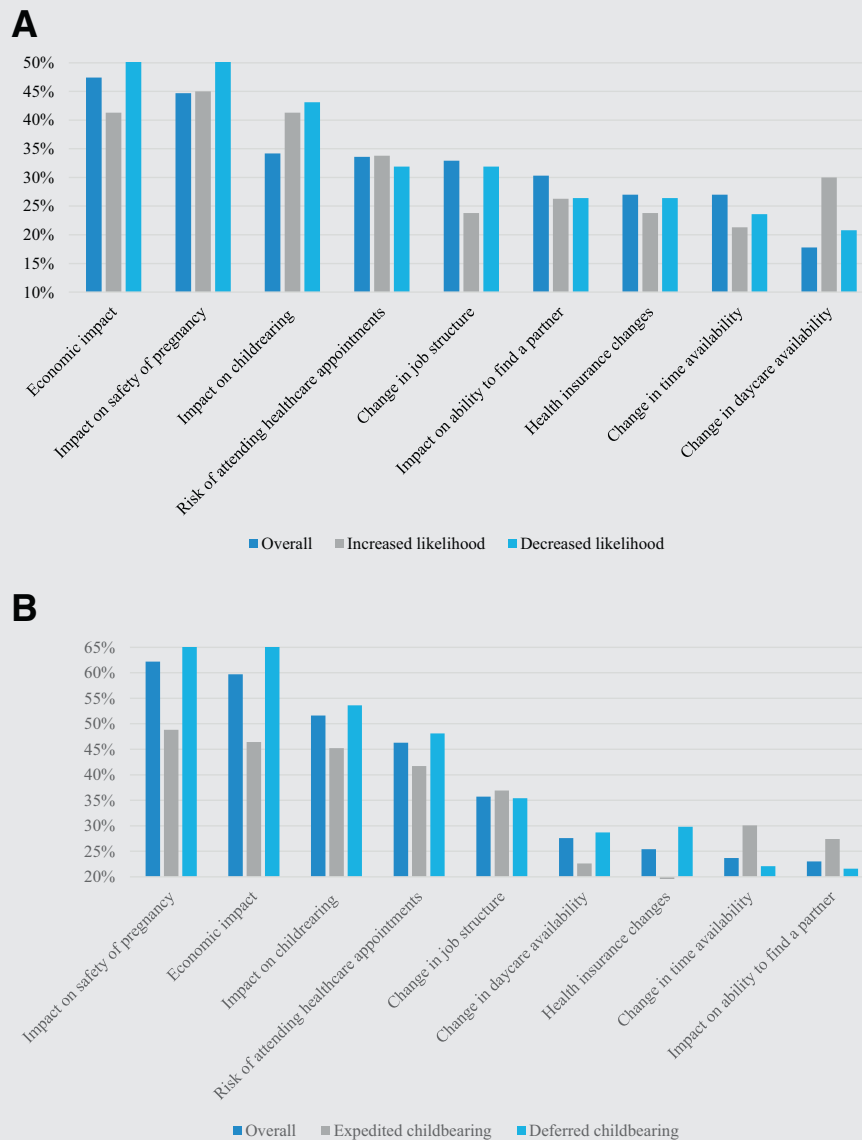


future), whereas 47.3% (n = 72) reported that the pandemic decreased their likelihood of considering OC (30.9% [n = 47] in the present and 16.4% [n = 25] in the future) (Fig. 1). The pandemic's economic impact, concerns regarding the safety of pregnancy/childbirth, and safety of childrearing were cited by these 152 respondents as most influential on the likelihood of considering OC (47% [n = 72], 45% [n = 68], and 34% [n = 52], respectively; allotted unlimited answer selections) (Fig. 2A). Knowledge of reproductive health and the OC process was not associated with a self-reported change in the likelihood of considering OC because of the pandemic (mean score 3.55/10 ± 1.24 points for those who did report a change compared with 3.71/10 ± 1.36 points for those who did not report a change, P=.17). COVID-19 infection, exposure to COVID-19 at work, race, ethnicity, age, insurance status, changes in insurance or employment status because of the pandemic, and relationship status were associated with a reported change in the likelihood of considering OC because of the pandemic. In a multivariable model, history of personal COVID-19 infection (odds ratio [OR] 1.57; 95% confidence interval [CI] 1.00–2.45), government-subsidized insurance (OR 1.47; 95% CI 0.97–2.21), change in insurance status because of the pandemic (loss of insurance [OR 2.32; 95% CI 1.15–4.66]; switch from private to government-subsidized insurance [OR 2.73; 95% CI 1.37–5.46]), change in employment status because of the pandemic manifested as working more (OR 2.99; 95% CI 1.62–5.51) or working

less (OR 2.54; 95% CI 1.65–3.90), and relationship status (divorced, separated, or widowed; OR 0.44; 95% CI 0.20–0.99) were significant risk factors for a change in the likelihood of considering OC. Variables did not demonstrate a signal of collinearity (all VIF < 1.53).

The overall prevalence of those likely to consider OC was 21.3% (n = 213). Neither a personal history of COVID-19 infection nor a history of COVID-19 infection in family/friends was associated with reported likelihood of considering OC (P=.77 and 0.64, respectively). However, contact with a COVID-19–positive individuals at work and increased time working remotely because of the pandemic were associated with likelihood of considering OC (P<.01 and P=.01, respectively). Further, experiencing a change in employment status because of the pandemic, whether that entailed working more (becoming employed or switching to full-time) or working less (becoming unemployed, furloughed, or switching to part time), was associated with likelihood of considering OC (P=.022). Changes in health insurance because of the pandemic were not associated with likelihood of considering OC (P=.13). There was no significant difference in knowledge of reproductive health and the OC process between those likely to consider OC (mean score 3.62/10 ± 1.32 points) and those unlikely to consider OC (mean score 3.70/10 ± 1.35 points) (P=.47). In a multivariable model considering age, parity, relationship status, employment status, change in employment status because of the pandemic manifested as each working more and working less, income,

FIGURE 2



(A) Mechanisms by which the COVID-19 pandemic influenced the likelihood of considering OC. *Dark blue* represents participants who believed that the pandemic influenced their likelihood of considering OC in the present or in the future (n = 152). *Light gray* represents participants who expressed an increased likelihood of considering OC (n = 80). *Light blue* represents participants who expressed a decreased likelihood of considering OC (n = 72). (B) Mechanisms by which the COVID-19 pandemic influenced childbearing plans. *Dark blue* represents participants who believed that the pandemic influenced their childbearing plans (n = 283). *Light gray* represents participants who expedited childbearing (n = 84). *Light blue* represents participants who delayed childbearing (n = 181). Of note, 18 participants selected “other” for how the pandemic influenced their childbearing plans and are not included in this figure. OC = planned oocyte cryopreservation.

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knowledge of reproductive health and the OC process, vaccination status, and exposure to COVID-19 at work, nulliparity and exposure to COVID-19 at work remained the strongest predictors of likelihood of considering OC (OR for nulliparity 1.97; 95% CI 1.41-2.76, and OR for COVID-19 exposure 1.86; 95% CI 1.35-2.58). Variables did not demonstrate a signal of collinearity (all VIF < 1.4).

### Impact on Childbearing

Among the respondents, 28.3% (n = 283) believed that the COVID-19 pandemic influenced their plans regarding childbearing, with 64.0% (n = 181) of this group noting that the pandemic caused them to defer childbearing and 29.7% (n = 84) expressing that the pandemic made them want to expedite childbearing. As with OC, the pandemic’s economic

impact, concerns regarding the safety of pregnancy/childbirth, and safety of childrearing were cited by these 283 participants as most influential on childbearing (60% [ $n = 169$ ], 62% [ $n = 176$ ], and 52% [ $n = 146$ ], respectively) (Fig. 2B). Of the total sample, 87.5% ( $n = 875$ ) cited having a safe environment to raise children as important in determining when to have a child.

Of the 18.1% ( $n = 181$ ) of the total sample that deferred childbearing because of the COVID-19 pandemic, 6.6% ( $n = 12$ ) reported an increased likelihood of considering OC in the present and 12.7% ( $n = 23$ ) in the future. Of the total respondents who reported an increased likelihood of considering OC in the present or in the future ( $n = 80$ ), 71.3% ( $n = 57$ ) also reported that the pandemic altered their childbearing plans, with 61.4% ( $n = 35$ ) of this group deferring childbearing.

### Vaccination

At the time of survey dissemination in May 2021, approximately 40% of the United States' population had received at least 1 dose of COVID-19 vaccine (8). Similarly, 42.5% ( $n = 425$ ) of the survey respondents reported receiving at least 1 dose of a COVID-19 vaccine at the time of survey completion (Supplemental Fig. 1, available online). Of those, 84.1% ( $n = 512$ ) who were vaccinated or planning to become vaccinated ( $n = 609$ ) believed that vaccination did not alter their childbearing plans. Further, most of this cohort (86.9%,  $n = 529$ ) did not believe that vaccination changed their likelihood of considering OC. Of the 57.5% of the sample that was unvaccinated ( $n = 575$ ), 68% ( $n = 391$ ) reported no plan to receive a vaccine when it was made available to them. Of these 68%, 72.6% ( $n = 284$ ) would not consider receiving a vaccine at any point. Most of these 284 respondents believed that not becoming vaccinated did not influence their childbearing plans or likelihood of considering OC (95.8% [ $n = 272$ ] and 98.6% [ $n = 280$ ], respectively). There was no significant difference in vaccination rates between those who would consider OC and those who would not (48.36% [ $n = 103/213$ ] vs. 40.9% [ $n = 322/787$ ],  $P = .051$ ), and vaccination status did not differ among those who noted that the COVID-19 pandemic altered their likelihood of considering OC compared with those who did not note a change in OC preferences ( $P > .05$ ).

### DISCUSSION

This study sought to evaluate the impact of the COVID-19 pandemic on a woman's reproductive decision-making, specifically regarding interest in pursuing OC. Importantly, this study was designed to evaluate the interest in OC among the general population and not within a population of women already interested in OC. Despite approximately 30% of the sample reporting that the pandemic influenced childbearing plans, only 15.2% believed that it influenced their likelihood of considering OC. Less than 20% of the participants who deferred childbearing because of the pandemic were more likely to consider OC in the present or in the future. This is an

unexpected result, as we hypothesized that women who were deferring fertility would be more interested in OC, given concerns about age-related fertility decline. It is possible that women did not anticipate deferring fertility for an extended period to experience appreciable fertility decline, were reluctant to present to health care facilities because of concern about viral exposure, or considered embryo cryopreservation rather than OC. Conversely, only 71.3% of the participants who reported an increased likelihood of considering OC because of the pandemic believed that the pandemic altered their childbearing plans, of which 38.6% actually expedited childbearing. This suggests that fertility preservation in the setting of deferral of childbearing is not the only motivation for pursuing OC.

Of those whose interest in OC was influenced by the pandemic, participants were most likely to state that the pandemic either increased their likelihood of considering OC in the future or decreased their likelihood of considering OC in the present. The economic impact of the pandemic was the factor most commonly cited as influential on the consideration of OC, and changes in employment and insurance status because of the pandemic were associated with a change in the likelihood of considering OC. Therefore, it is plausible that women who faced financial challenges because of the pandemic may be less likely to consider OC in the present because of the inability to afford the services.

Although personal COVID-19 infection or infection in family members or friends were not associated with the overall likelihood of considering OC, personal COVID-19 infection was associated with a change in the likelihood of considering OC because of the pandemic. The decision to become vaccinated was not associated with consideration of OC in the statistical analysis, which was concordant with most of the participants' self-reported perception that vaccination status did not influence their likelihood of using this service.

Increased time working remotely because of the pandemic and contact with COVID-19-positive individuals at work were associated with a higher overall likelihood of considering OC. It is plausible that working from home limited new or existing interpersonal interactions and potential identification of a partner with whom to pursue childbearing and/or provided greater flexibility to attend appointments for OC. Similarly, COVID-19 exposure at work may increase an individual's hesitance to engage in social interactions because of concerns about infectivity and/or persistently reinforce safety concerns associated with the pandemic, which may support consideration of OC. These reported interactions may be confounded by employment status, as both increased time working remotely and contact with COVID-19 at work imply current employment.

Interestingly, race and relationship status, which were previously identified as predictors of considering OC within a comparable sample, were not associated with likelihood of considering OC in this cohort (6). Further, parity, which had not been found to be predictive in previous analyses, was found to be significantly associated with consideration of

OC in this cohort. These changes in the demographic predictors of consideration of OC possibly reflect the evolution of the population seeking out these services over time.

Approximately one-third of participants believed that the pandemic influenced their childbearing timeline, which corroborates the downward trend in this value that is highlighted by the 2020 and 2021 Guttmacher Survey of Reproductive Health Experiences (GSRHE) analyses (2, 4). In 2020, before our survey distribution, 41% of GSRHE respondents noted a change in fertility plans because of the pandemic, and in GSRHE 2021—distributed 2–3 months after our survey—22% reported a change in fertility plans (2, 4). Of the participants in the present study who reported a change in their childbearing timeline because of the pandemic, twice as many participants deferred childbearing as those who expedited (18.1% vs. 8.4%). These values more closely approximate the respective percentages reported in GSRHE 2021 (15% deferred or wanted fewer children compared with 11% who expedited or wanted more children), which is expected based on temporal proximity of survey completion (4). The cited reasons for change in childbearing timeline are consistent with those reported in GSRHE 2021; fear of pregnancy and childbirth, concerns regarding optimal childrearing environment, and financial concerns were the most common reasons for deferring childbearing (4). Given that most participants in this study cited the pandemic's impact on the safety of pregnancy, childbearing, and childrearing as factors influencing their childbearing decision-making, it is interesting that 8.4% of the sample desired to expedite childbearing because of the pandemic. Perhaps this represents a fear that the pandemic would only worsen over time, with safety only becoming increasingly precarious in the future. An alternative explanation is suggested by the most commonly selected reason for expediting childbearing in GSRHE 2021, which was that the pandemic made respondents “focus on what is important in life.”

This study substantially adds to the existing literature pertaining to the COVID-19 pandemic's influence on reproductive decision-making. The study design and method of survey dissemination allowed for the analysis of a sample with a racial and ethnic composition and rates of COVID-19 infection and vaccination comparable to those of the United States population (8–11). A larger proportion of this study population had earned higher-education degrees compared with the United States' population, the sample's rate of unemployment was slightly higher than the national percentage (12.7% in this cohort compared with 5.3% of women aged  $\geq 20$  years in May 2021) (11) and  $>70\%$  of the sample reported a total income lower than the national median (10) thereby limiting generalizability. The higher than national average unemployment rate of 12.7% included those who had experienced job loss because of the pandemic but may also reflect selection bias in that unemployed persons may have a greater opportunity to complete an online survey. Despite these discrepancies, the study population was overall representative of the general United States' population, thereby reinforcing the generalizability of our results.

This study was limited by its retrospective survey-based design, as all participant characteristics and pandemic-influenced changes that impacted reproductive decision-making may not have been captured. The analysis relied on a self-reported change in the likelihood of considering OC, as participants' plans regarding OC and childbearing before the pandemic were unknown. In addition, not varying the administration order of the questions represents a limitation in the ability to control for demand effect. Further, although the survey was distributed at a time when nearly half of the country was vaccinated in attempt to best evaluate the impact of vaccination on fertility preferences, these results represent the preferences of respondents at an isolated point in the pandemic and, therefore, do not capture the evolving impact of the pandemic as it is influenced by changes in restrictions, vaccination availability and requirements, and viral variants. Additionally, the survey distribution was subject to selection bias in that the respondents were limited to those using internet services and willing to complete the full survey. Although the partial survey completion rate was not available to estimate the degree of this bias, it is plausible that individuals interested in OC may be more motivated to complete the full survey, permitting an overestimate of the likelihood of considering OC.

The results of this study provide preliminary data to inform previously unexplored questions in the literature, including the impact of the COVID-19 pandemic not only on childbearing preferences but also on perceptions of OC, the motivation behind these changes in fertility preferences, and the role of vaccination in these changes. Additional analyses are necessary to fully elucidate the evolving and long-term impact of the COVID-19 pandemic on reproductive decision-making, particularly with regard to fertility preservation.

## CONCLUSION

The COVID-19 pandemic's economic impact and its influence on the perceived safety of pregnancy, childbirth, and childrearing have altered the likelihood of considering OC in  $>15\%$  of reproductive-aged women. Approximately 30% of women believe that their reproductive timelines have been affected by the pandemic. COVID-19 vaccination has not significantly modified these changes.

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