Telemedicine utilization and perceived quality of virtual care among pregnant and postpartum women during the COVID-19 pandemic

Ann Davis1 and Dani Bradley2

Abstract
Introduction: The aim of this research was to examine the association between perceived quality of care during the COVID-19 pandemic and the modality of maternity care visits, virtual or in-person.

Methods: This study utilized an online nationwide survey about experiences in prenatal and postpartum care between 18 April and 6 August 2020. Perceived quality of care was categorized into worse care, better, or the same care as compared to before the pandemic. Barriers were categorized into five groups: (1) concern for the privacy of health information, (2) not having a private or quiet place, (3) lack of physical exam or measurements, (4) quality of care, and (5) technology issues. Data analyses included bivariate analyses and multivariate logistic regression.

Results: The majority (75.3%) of modified visits utilized telemedicine. Over half of the women took at-home measurements and the majority were successful. Barriers to care included a lack of a quiet or private space to conduct their visit. Women expressed concerns about a lack of measurements and a lower quality of care. Women who received telemedicine visits perceived worse care as compared to women who received in-person care visits (OR = 5.62; 95% CI 5.01–6.31).

Discussion: Previous studies have shown that pregnant patients are generally satisfied with virtual care during the pandemic. This study provides insight from a large nationwide sample of women and geographic variation in satisfaction and perceived quality. These findings highlight barriers and potential solutions to improving patients’ perceived quality of virtual maternity care, and thus future uptake of high-quality, virtual care.

Keywords
Pregnancy, prenatal care, COVID-19, postpartum, telemedicine, virtual care, digital health, maternity care

Date received: 13 July 2022; Date accepted: 1 October 2022

Introduction
Prenatal care is an essential preventive service during pregnancy designed to improve outcomes for mother and baby through a series of scheduled visits with an obstetric healthcare provider.1 In the United States, these recommended 12 to 14 in-person visits during pregnancy have remained unchanged for almost a century.2 In recent years, telehealth has been integrated into many aspects of obstetrics, including prenatal care. This includes traditional clinical diagnosis and monitoring that is delivered by use of technology such as virtual visits and remote patient monitoring.3,4 Studies have shown that the use of telemedicine for routine prenatal care can deliver comparable or even added benefits in obstetric outcomes.5 Studies have also reported patient satisfaction with integrating components of virtual prenatal care for low-risk patients.6-8

The COVID-19 pandemic introduced enormous challenges for healthcare access and delivery, especially for high-risk populations. Healthcare institutions and providers

1March of Dimes, Arlington, VA, USA
2Ovia Health, Boston, MA, USA

Corresponding authors:
Ann Davis, March of Dimes, 1550 Crystal Dr, Suite 1300, Arlington, VA 22202, USA.
Email: amdavis@marchofdimes.org
Dani Bradley, Ovia Health, 308 Congress St, Boston, MA 02210, USA.
Email: danibradley25@gmail.com
had to rapidly implement new systems, integrating virtual elements, to meet social distancing guidelines while providing continuity of care. Alternate or reduced prenatal care schedules were suggested by organizations such as the American College of Obstetricians and Gynecologists and others. Modifications incorporated telemedicine via video or phone visits complemented by remote monitoring to provide support in between reduced in-person visits. Successful transitions to new prenatal care models during the COVID-19 pandemic have been reported and include incorporating elements of telemedicine. While some of these studies included surveys regarding patient satisfaction with particular prenatal care programs, more information from the patients’ perspective is needed. In order to successfully transition to more remote-based care, addressing issues such as problems with virtual/remote aspects of care, perceptions about the quality of care, and barriers to care would be useful. The aim of this study was to examine the patient-perceived quality and barriers of virtual prenatal care in the U.S. during the COVID-19 pandemic through a survey of pregnant and postpartum women.

Methods

The survey was emailed to 130,000 users of the mobile app, Ovia Pregnancy. Women were invited to participate in a 16- to 51-item survey (depending on branching logic), regarding their experience with prenatal and postpartum care during the pandemic. Data presented include responses submitted from April 18 through 6 August 2020. Race was categorized into self-reported categories of white, black, Hispanic, and other. Other included Asian (including Native Hawaiian and other Pacific Islanders), American Indian/Alaskan Native, Middle Eastern, or other. Relationship status was categorized into single (including divorced, separated, and widowed) and married or committed relationships. Insurance categories were private insurance, Medicaid or Medicare, or other (including military, Indian Health Service, or individual health insurance), and none. Respondents were asked if they had been told by their healthcare provider that their pregnancy was high-risk. If yes, they were asked to provide the reason.

To examine barriers or concerns to telemedicine, women were asked if they had concerns about the privacy of their health information or if they experienced difficulty in finding a quiet or private place to conduct their visit. Additionally, women had the option to share other concerns or problems they experienced. Responses to the open-ended question were categorized into the following themes:

- Lack of measurements or physical exam
- Technology issues or bad connection
- Quality of care

These responses were stratified by type of visit, prenatal or postpartum.

Dependent variable

The outcome of this study was the perceived quality of care during the perinatal period during the COVID-19 pandemic. Women were asked the following question “Do you feel that you are getting the same quality of care, regarding your pregnancy or postpartum health that you were getting prior to the COVID-19 pandemic?” Women were categorized into those who perceived worse care (“I feel the quality of my care has worsened”) and those with the same or better-perceived care (“I feel that the quality of my care has improved/ is the same”). Women who were recently pregnant and did not have previous appointments for reference were excluded from the analysis.

Independent variable

Women were asked “Did your prenatal/postpartum visit in the past four weeks occur as usual? How was your visit modified?” Those that occurred in a usual setting were considered in-person visits, even if other modifications were needed, such as mask-wearing. Modified visits were further described as telemedicine visits if they were conducted through video or telephone.

Analysis

Descriptive statistics are presented as frequencies and percentages by type of visit and demographic characteristics of our survey population. Differences among the type of visits were compared statistically using chi-square tests. Multivariate logistic regression models were utilized to assess the association of demographic characteristics and the likelihood of perceived worsened quality of care. Analyses were conducted using SAS statistical software (SAS 9.3; SAS Institute, Inc., Cary NC). The significance level was set at \( p < 0.05 \). All models were adjusted for maternal age, maternal race/ethnicity, income, insurance type, education, trimester, first or subsequent pregnancy, high-risk pregnancy, relationship status, and region of the US.

Ethical approval and exemption for this study was approved by Advarra Institution Review Board.

Results

A total of 16,972 women responded to the survey; the response rate was 13%. The completion rate for the survey was 76%. For both prenatal and postpartum care, a total of 16,418 women reported a visit to a healthcare provider (Figure 1). Of the maternity care visits that occurred between 18 April and 6 August 2020, 18.5% were modified. The majority (83.2%, \( n = 2054 \)) were prenatal care...
visits. The most common modification (75.3%, n = 1858) was video or phone format. A total of 1506 telemedicine visits (either phone or video) occurred for pregnant women and 352 telemedicine visits for postpartum women. Additionally, 205 (1.5%) visits were canceled and 358 (2.7%) were rescheduled.

Other modifications to visits (20.9%) included the required use of masks by self and healthcare staff, change of location, no spouse or partner allowed in the visit, and the combination of multiple visits into one (Table 1). Vermont, Oregon, and Massachusetts reported the highest percentage of telemedicine use among respondents (32%, 30.7%, and 30.1%, respectively).

The mean age of women was 31.1 years and the mean gestational age was 22.7 weeks. Women who utilized telemedicine were significantly higher in weeks of gestation (25.3 vs. 23.6; p<0.01) than those who had an in-person visit. Approximately one-quarter of women (23.9%, n = 3159) reported being considered a high-risk pregnancy (Table 2). The most common reason for high risk was advanced maternal age. Other reasons for high-risk status include chronic disease, such as hypertension or diabetes, in vitro fertilization, or gestational diabetes. Our survey population had a high percentage of non-Hispanic white women (82.1%). Respondents on average were older with 23.5% being over 35 years and the majority (87.1%) had private insurance. Responses came from all 50 states, Washington D.C., Puerto Rico, and the Virgin Islands.

At-home measurements

Almost half (45.2%, n = 840) of women who had telemedicine visits were asked to take self-measurements (Table 1). The most common self-measurements were blood pressure (n = 663), weight (n = 685), and fundal height (n = 42). Other self-measurements reported were baby’s heartbeat, temperature, blood sugar, pulse, urine test, postpartum measurements, and a mental health check.

The majority (89.7%, n = 749) of women reported successfully being able to take measurements at home. Fundal height measurements were the most unsuccessful (14%). Additionally, 10% of the weight and 9% of the blood pressure measurements were unsuccessful. Women who took home measurements were often asked to take multiple measurements. Measurement success did not significantly differ by race, region, or woman’s trimester. However, significant differences were noted by insurance type, income, maternal age, and education, and results not shown.
Table 1. Description of visit modification and at-home measurements.

| Visit modification, n(%)       | Yes 2469 (18.5) | No 10,347 (77.3) |
|--------------------------------|-----------------|------------------|
| Preferred visit modification, n(%) | Home visit 768 (31.1) | Other 72 (2.9) |
|                               | Rescheduling 441 (17.9) | Telephone 448 (18.1) |
|                               | Video 1303 (52.8) | Visit type, n(%) |
|                               | Prenatal 2054 (83.2) | Postpartum 415 (16.9) |
|                               | Type of modification, n(%) | Type of self-measurements, n(%) |
|                               | Video 1017 (41.2) | Weight 685 (36.9) |
|                               | Phone 841 (34.1) | Fundal height 42 (2.3) |
|                               | Location change 96 (3.9) | Blood pressure 663 (35.7) |
|                               | Other 515 (20.9) | Baby heartbeat 59 (3.2) |
| Asked to take at-home measurements, n(%) | Yes 840 (45.2) | Temperature 20 (1.1) |
|                               | No 1018 (54.8) | Blood sugar 10 (<1.0) |
|                               | Prenatal 2054 (83.2) | Pulse 4 (<1.0) |
|                               | Postpartum 415 (16.9) | Urine test 7 (<1.0) |
|                               | Type of modification, n(%) | Postpartum—baby weight, other 2 (<1.0) |
|                               | Video 1017 (41.2) | Mental health check 1 (<1.0) |
| Type of self-measurements, n(%) | Weight 685 (36.9) | Measurement success, n(%) |
|                               | Fundal height 42 (2.3) | Yes 749 (89.7) |
|                               | Blood pressure 663 (35.7) | No 86 (10.3) |
|                               | Baby heartbeat 59 (3.2) |
|                               | Temperature 20 (1.1) |
|                               | Blood sugar 10 (<1.0) |
|                               | Pulse 4 (<1.0) |
|                               | Urine test 7 (<1.0) |
|                               | Postpartum—baby weight, other 2 (<1.0) |
|                               | Mental health check 1 (<1.0) |

Barriers to telemedicine visits

The majority of women (58.7%, n = 1090), reported no difficulties in conducting their visits via telemedicine (Table 3). Postpartum women expressed higher levels of concern with finding a quiet place to attend their visit and concerns over health information privacy. Concerns about lack of measurements or physical exams were consistent across pregnant and postpartum women (16.5%). Specific concerns raised by postpartum women were the unavailability of physicians to discuss postpartum depression, birth control, and lactation concerns. The most common concerns related to lack of measurements include not being able to hear the baby’s heartbeat and the inability to assess healing postpartum. Many of the women who reported a lack of physician interaction stated that calls were rushed and had less personal attention. One woman reported, “It feels like minimal care.” The lack of face-to-face interaction left women feeling that they could not ask everything on a call that they would have asked in person.

Perceived quality of care

About half (51.5%, n = 957) of women who received a modified visit stated receiving less information than previous in-person visits (Table 4). Additionally, women who received care through telemedicine were more dissatisfied with the communication they received from their healthcare provider about COVID-19 than in-person visits (OR = 2.08 (95% CI 1.69–2.56)), results not shown.

Perceptions of quality of care differed between telemedicine visits and in-person visits. Women who received care through telemedicine were more likely to perceive a worse level of care after adjusting for confounders (OR = 5.74 (95% CI 4.96–6.65)) (Table 5).

Among telemedicine visits, differences were noted between video and phone visits. When adjusting for confounders, women who received telemedicine via phone had a greater magnitude of perceived worse care than a video visit, with 6.52 and 5.14 greater likelihood, respectively (Table 5).

Women who were 35 or older were more likely to report the same level of care or improvement in their care when using telehealth (OR = 0.76 (95% CI 0.64–0.90)) (Table 5) compared to younger respondents. No significant differences in perceived quality were reported by race, income, education, or parity. Women who were in their second trimester were more likely to perceive worse care than women in their first trimester (OR = 1.39 (95% CI 1.09–1.79)). Compared to states in the southern region of the U.S., those in the northeast and west perceived worse care (OR = 1.69 (95% CI 1.41–2.03) and OR = 1.63 (95% CI 1.35–1.96), respectively). Women who considered themselves high-risk and had a visit via telemedicine reported worse perceived care overall (OR 1.25 (95% CI 1.06–1.46)). Women who reported worse perceived care were more likely to be covered by other insurance as compared to private insurance (OR 2.14 (95% CI 1.41–3.23)) (Table 5).

Discussion

Recommendations to alter in-person prenatal and postpartum care visits to reduce exposure during the pandemic were necessary public health measures to decrease risk to a high-risk population. These recommendations included the reduction of in-person visits complemented by virtual visits and recommendations for virtual postpartum visits if possible. The findings from this study provide significant insight into difficulties faced by women when accessing maternity care services through telemedicine.

In this survey of over 13,000 pregnant or postpartum women, 13.9% experienced a telehealth visit. Prior to the pandemic, 0.1% of maternity care visits were virtual. Among our study participants (11.2%) had a virtual healthcare visit prior to the pandemic. This
demonstrates a willingness to participate in telemedicine and an interest by providers that has the potential to increase.

Our study adds information on geographic differences in how women are experiencing care during the pandemic. Patients in the northeast and west regions of the U.S.

| Table 2. Demographics of survey respondents, pregnancy survey (N = 13,379). |
|---------------------------------------------------------------|
| | Telemedicine (n = 1858) | In-person (n = 10,347) | Total* (n = 13,379) | P-value |
| Age, n (%) | | | | |
| Mean (SD) | 31.4 (4.4) | 31.0 (4.4) | 31.1 (4.7) | 0.757 |
| Under 35 | 1411 (75.9) | 7892 (76.3) | 10,236 (76.5) | 0.006 |
| 35 or older | 447 (24.1) | 2455 (23.7) | 3143 (23.5) | |
| Race/ethnicity, n (%) | | | | |
| White | 1511 (83.5) | 8226 (81.6) | 10,696 (82.1) | <.001 |
| Black | 102 (5.6) | 802 (8.0) | 970 (7.5) | |
| Hispanic | 126 (7.0) | 701 (7.0) | 900 (6.9) | |
| Other | 71 (3.9) | 350 (3.5) | 461 (3.5) | |
| Pregnancy status, n (%) | | | | |
| Currently pregnant | 1506 (81.1) | 8956 (86.6) | 11,493 (85.9) | <.001 |
| Recently delivered | 352 (19.0) | 1391 (13.4) | 1886 (14.1) | |
| Gestational week, mean (SD) | 25.3 (9.1) | 23.6 (10.0) | 22.7 (10.4) | 0.115 |
| Trimester, n (%) | | | | |
| First | 545 (29.3) | 2838 (27.4) | 3671 (27.4) | <.001 |
| Second | 557 (30.0) | 3322 (32.1) | 4257 (31.8) | |
| Third | 756 (40.7) | 4187 (40.5) | 5451 (40.7) | |
| High risk, n (%) | | | | |
| Yes | 298 (20.4) | 2201 (19.7) | 3159 (23.9) | <.001 |
| No | 1165 (75.5) | 6537 (61.3) | 10,043 (76.1) | |
| Number of children, n (%) | | | | |
| I just gave birth and have one or more older children | 148 (8.0) | 599 (5.8) | 823 (6.2) | <.001 |
| I just gave birth to my first child | 205 (11.0) | 803 (7.8) | 1080 (8.1) | |
| I’m pregnant and have one or more older children | 554 (29.8) | 3564 (34.5) | 4502 (33.7) | |
| I am pregnant with my first child | 951 (51.2) | 5379 (52.0) | 6972 (52.1) | |
| Relationship status, n (%) | | | | |
| Married or in a committed relationship | 1815 (96.5) | 9942 (96.5) | 12,888 (96.7) | 0.004 |
| Single | 41 (2.2) | 363 (3.5) | 437 (3.3) | |
| Education level, n (%) | | | | |
| High School or less | 268 (14.6) | 2037 (19.9) | 2497 (18.9) | <.001 |
| Associates | 200 (10.9) | 1285 (12.6) | 1639 (12.4) | |
| BS | 739 (40.2) | 3881 (37.9) | 5068 (38.3) | |
| Master’s or higher | 633 (34.4) | 3040 (29.7) | 4040 (30.5) | |
| Income, n (%) | | | | |
| <$20,000 | 35 (2.1) | 472 (5.1) | 550 (4.6) | <.001 |
| $20,000–$59,999 | 259 (15.5) | 1747 (19.0) | 2193 (18.4) | |
| $60,000–$99,999 | 475 (28.5) | 2670 (29.0) | 3461 (29.1) | |
| $100,000+ | 898 (53.9) | 4312 (46.9) | 5704 (47.9) | |
| Insurance, n (%) | | | | |
| Private insurance | 1560 (91.1) | 81,91 (86.3) | 10,694 (87.1) | <.001 |
| Medicaid/medicare | 107 (6.3) | 1078 (11.4) | 1290 (10.5) | |
| Other | 33 (1.9) | 165 (1.7) | 222 (1.8) | |
| None | 12 (0.7) | 56 (0.6) | 77 (0.6) | |
| Region, n (%) | | | | |
| Northeast | 517 (27.8) | 2075 (20.1) | 3448 (21.0) | <.001 |
| Midwest | 427 (23.0) | 2369 (22.9) | 3812 (23.2) | |
| West | 500 (26.9) | 2068 (20.0) | 3514 (21.4) | |
| South | 414 (22.3) | 3835 (37.1) | 5644 (34.4) | |

*Total includes those visits that were canceled or rescheduled or otherwise modified. Percentages may not sum to 100% due to rounding.
perceived their care to be worse than those in the southern region. This may be attributed to differences in regional policies in pandemic response, for example, coastal states with large cities experienced stricter guidelines than those in other regions of the country. The higher rate of usage in the northeast region may contribute to these differences. Additional causes may include access to broadband internet and geographic differences in rural and urban living.

This study found that the majority of women (56.4%) who engaged with telemedicine expressed better or the same levels of perceived care. This supports previous research that examined perceptions and satisfaction of patients and virtual care necessitated by pandemic conditions. Although our study did not explore reasons for increased satisfaction, previous studies have attributed this to convenience, partners being able to attend, and decreased barriers to childcare or transportation.

Our study increased the knowledge of patients’ perspectives on barriers to care and concerns. Our study participants expressed greater levels of perceived worse care when receiving telemedicine during the pandemic as compared to women receiving in-person care. Other studies on satisfaction have also reported patients expressing increased discomfort, hesitation, and anxiety in using telehealth. A recent systematic review demonstrated that the prevalence of anxiety, depression, insomnia, and psychological stress was high in pregnant women during the pandemic. The dissatisfaction that we see in our results may be due to a lack of control over day-to-day activities and concern/anxiety about pregnancy during a pandemic. Not being able to see a physician in person and receive desired reassurance may amplify concerns. Specific barriers addressed by our respondents included quality of care, lack of physical exams or measurements, health information privacy, and having an adequate space to conduct virtual care.

| Concerns or barrier                                      | Pregnant women n (%) | Postpartum Women n (%) | Total n (%) |
|----------------------------------------------------------|-----------------------|------------------------|-------------|
| Concerned about privacy of health information            | 53 (3.5)              | 21 (6.0)               | 74 (4.0)    |
| Concerned about not having a quiet or private place      | 143 (9.5)             | 66 (18.8)              | 209 (11.2)  |
| Lack of measurements or physical exam (fetal heartbeat, blood pressure, fundal height, physical postpartum check) | 249 (16.5)             | 58 (16.5)              | 307 (16.5)  |
| Technology issues (poor connection, lack of access)     | 33 (2.2)              | 7 (2.0)                | 40 (2.2)    |
| Quality of care                                          | 157 (10.4)            | 45 (12.8)              | 202 (10.9)  |
| None                                                     | 900 (59.8)            | 190 (54.0)             | 1090 (58.7) |
| Total of telemedicine visits                             | 1506                  | 352                    | 1858        |

aWomen may have given more than one response. Percentages by the total type of visit.

Table 3. Concerns or barriers reported by women utilizing telemedicine.

| Concerns or barrier                                      | Telemedicine visit (n = 1858) | In-person visit (n = 10,347) | P-value |
|----------------------------------------------------------|-------------------------------|------------------------------|---------|
| Quality of modified care n (%)                           | 735 (39.6)                    | 1105 (10.7)                  | <0.001  |
| Worsened                                                 | 920 (49.5)                    | 7228 (69.9)                  |         |
| Improved                                                 | 32 (1.7)                      | 822 (7.9)                    |         |
| Don’t know (not pregnant before the pandemic began)      | 171 (9.2)                     | 1192 (11.5)                  |         |
| Amount of information                                    | NA                            | NA                           |         |
| Same                                                     | 850 (45.8)                    | NA                           |         |
| Less                                                     | 957 (51.5)                    | NA                           |         |
| More                                                     | 51 (2.7)                      | NA                           |         |
| Satisfaction on COVID-19 information from provider       | 110 (5.9)                     | 374 (3.6)                    | <0.001  |
| Dissatisfied                                             | 257 (13.8)                    | 1143 (11.1)                  |         |
| Somewhat satisfied                                       | 918 (49.4)                    | 4537 (43.9)                  |         |
| Satisfied                                                | 573 (30.8)                    | 4293 (41.5)                  |         |

Table 4. Self-reported quality and content of visit by telemedicine or usual visit.
who can answer questions and provide more personalized care to patients could help reduce patient concerns. These results also demonstrate a need for additional digital support services and solutions to fill patient-perceived gaps in care.

Examination of the postpartum experience with virtual care mirrored overall responses, such as women expressing concern due to no physical exam. Postpartum women expressed specific concerns about healing after cesarean section and vaginal tears. Additionally, as in previous research, participants expressed concern about not being able to discuss postpartum depression and birth control. In usual care settings, one in eight women is not asked about depression at their postpartum visit.

Table 5. Adjusted association between telemedicine visit and perceived worse care (n = 7216).

| Visit | Model 1: in-person versus telemedicine | Model 2: in-person versus video visit | Model 3: in-person versus phone visit |
|-------|--------------------------------------|--------------------------------------|--------------------------------------|
| In-person | Ref | Ref | Ref |
| Telemedicine | 5.74 (4.96–6.65) | 5.14 (4.27–6.18) | 6.52 (5.34–7.96) |
| Video | Ref | Ref | Ref |
| Phone | Ref | Ref | Ref |

Maternal age

| Under 35 | 0.76 (0.64–0.90) | 0.72 (0.60–0.88) | 0.77 (0.64–0.93) |
| 35 or greater | Ref | Ref | Ref |

Maternal race

| White, non-Hispanic | Ref | Ref | Ref |
| Black, non-Hispanic | 0.99 (0.76–1.30) | 0.98 (0.73–1.31) | 0.97 (0.72–1.29) |
| Hispanic | 0.76 (0.57–1.01) | 0.83 (0.62–1.12) | 0.74 (0.54–1.00) |
| Other | 0.69 (0.46–1.04) | 0.63 (0.39–1.00) | 0.69 (0.44–1.09) |

Insurance

| Private | Ref | Ref | Ref |
| Medicaid/medicare | 0.90 (0.66–1.22) | 0.87 (0.62–1.20) | 1.03 (0.74–1.43) |
| None | 0.37 (0.11–1.25) | 0.55 (0.16–1.83) | 0.30 (0.07–1.33) |
| Other | 2.14 (1.41–3.23) | 2.04 (1.30–3.19) | 2.30 (1.51–3.52) |

Income

| <$20,000 | 0.97 (0.61–1.57) | 1.07 (0.65–1.77) | 0.88 (0.53–1.45) |
| $20,000–$59,999 | 0.92 (0.72–1.16) | 0.90 (0.70–1.17) | 0.86 (0.67–1.12) |
| $60,000–$99,999 | 0.89 (0.75–1.04) | 0.90 (0.75–1.06) | 0.83 (0.69–0.99) |
| ≥$100,000 | Ref | Ref | Ref |

Education

| High school or less | 1.07 (0.84–1.35) | 1.02 (0.79–1.32) | 1.04 (0.80–1.35) |
| Associate’s degree | 1.04 (0.82–1.33) | 1.03 (0.80–1.34) | 1.00 (0.77–1.30) |
| Bachelor’s degree | 0.99 (0.85–1.16) | 0.96 (0.81–1.14) | 0.94 (0.79–1.12) |
| Master of higher | Ref | Ref | Ref |

Trimester

| First | Ref | Ref | Ref |
| Second | 1.39 (1.09–1.79) | 1.35 (1.03–1.77) | 1.43 (1.09–1.87) |
| Third | 1.27 (1.00–1.61) | 1.31 (1.01–1.71) | 1.38 (1.07–1.79) |

Parity

| First pregnancy | 1.08 (0.94–1.24) | 1.08 (0.93–1.26) | 1.08 (0.93–1.26) |
| Not first pregnancy | Ref | Ref | Ref |

High risk

| Yes | 1.25 (1.06–1.46) | 1.23 (1.03–1.46) | 1.25 (1.05–1.48) |
| No | Ref | Ref | Ref |

Relationship

| Married | Ref | Ref | Ref |
| Single | 0.73 (0.45–1.17) | 0.66 (0.39–1.12) | 0.74 (0.45–1.21) |

Region

| Northeast | 1.69 (1.41–2.03) | 1.85 (1.53–2.24) | 1.68 (1.38–2.06) |
| Midwest | 1.12 (0.93–1.35) | 1.17 (0.96–1.43) | 1.07 (0.88–1.32) |
|West | 1.63 (1.35–1.96) | 1.63 (1.33–2.00) | 1.77 (1.44–2.16) |
|South | Ref | Ref | Ref |
prevalence of absent or inadequate screening for postpartum depression may lead to an increase in missed opportunities for referral to needed mental health services. The previous meta-analysis demonstrates that in controlled environments telemedicine has been shown effective in the treatment and management of maternal depression and anxiety.21

Our survey population reported higher rates of private healthcare coverage and higher education levels compared to the general U.S. population. Previous studies have found increased difficulties among those with Medicaid13 and utilization of virtual services. This group of women is underrepresented in our study. Barriers and concerns expressed by our population may be amplified in populations with lower levels of access and decreased education. Our population worried about the accuracy of measurements taken at home and many did not have home monitoring equipment; we expect this to be exacerbated in lower socioeconomic populations and those with low health literacy. Previous research on satisfaction and barriers to virtual care had similar population demographics as our study.14 This indicates an issue with assessing the effective uptake of virtual care in all populations.

This study demonstrates areas in which providers could give additional support to pregnant and postpartum women. This study also outlines where providers could leverage other telemedicine resources, such as pregnancy and postpartum-focused apps, to improve virtual care. Increased access to remote monitoring equipment and adequate education regarding the use of equipment, is likely to become an even greater concern for communities where access to such equipment is low. Our results also indicate patients prefer video care as opposed to care over the phone. Providers should utilize video visits when possible and make every effort to listen to patient concerns and questions during those visits. Provider scheduling modifications will be needed to allow for this enhanced quality of care.

This is the first nationwide survey of women’s perceptions of quality of care during the COVID-19 pandemic and how that differs by visit type. This study amplifies concerns and barriers that previous studies have shown in women who are pregnant or postpartum and using telemedicine services, as well as identifies potential solutions to some of these concerns.

Our study is not without limitations. Publicly, under and uninsured populations are underrepresented in our sample. Our study sample was not generalizable to the U.S. population. More than 80% of the study sample population identified as white and had higher income and education levels than the general U.S. population. Bias exists in the form of self-selection and self-reported conditions, such as high-risk pregnancy status. Last, our study cannot assess the effectiveness of virtual prenatal care as it relates to birth outcomes.

The use of telemedicine services in prenatal and postpartum care requires enhancements and modifications in order to provide care perceived to be of high quality to patients. Telemedicine use increased dramatically during the COVID-19 pandemic and this form of care is likely to continue. As in previous reviews, it is important that providers receive training to better provide adequate remote care and that technology and digital infrastructure, including digital patient education resources and remote patient monitoring devices, are leveraged to enhance the quality of virtual care and increase the routine use of telemedicine in obstetric care.22,23

Acknowledgements
We acknowledge the editorial contribution of the following individuals Motoko Oinuma, BA, Christina Brigance, MPH, Chasmine Flax, MPH, and Kathryn Mishkin, DrPH.

Declaration of conflicting interests
The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding
The authors received no financial support for the research, authorship, and/or publication of this article.

ORCID iD
Ann Davis https://orcid.org/0000-0001-8655-8416

References
1. Kilpatrick S, Papile L, Macones G, et al. Guidelines for perinatal care. 8th ed. Washington D.C, US: American Academy of Pediatrics/The American College of Obstetricians and Gynecologists, 2017.
2. Peahl AF and Howell J. The evolution of prenatal care delivery guidelines in the United States. Am J Obstet Gynecol 2021; 224: P339–P347.
3. Snoswell CL, Chelberg G, De Guzman KR, et al. The clinical effectiveness of telehealth: A systematic review of meta-analyses from 2010 to 2019. J Telemed Telecare 2021;1357633X211022907. doi: 10.1177/1357633X211022907. Epub ahead of print. PMID: 34184580.
4. ACOG Committee Opinion, Number 798. Implementing telehealth in practice. Obstet Gynecol 2020; 135: 493–494.
5. DeNicola N, Grossman D, Marko K, et al. Telehealth interventions to improve obstetric and gynecologic health outcomes: A systematic review. Obstet Gynecol 2020; 135: 371–382.
6. Butler Tobah YS, LeBlanc A, Branda ME, et al. Randomized comparison of a reduced-visit prenatal care model enhanced with remote monitoring. Am J Obstet Gynecol 2019; 221: 638.e1–638.e8.
7. Marko KI, Ganju N, Krapf JM, et al. A mobile prenatal care app to reduce in-person visits: Prospective controlled trial. JMIR Mhealth Uhealth 2019; 7: e10520.
8. Pflegeisen BM and Mou J. Patient satisfaction with virtual obstetric care. Matern Child Health J 2017; 21: 1544–1551.
9. American College of Obstetricians and Gynecologists. COVID-19 FAQs for obstetrician–gynecologists, obstetrics. Prenatal Care, https://www.acog.org/clinical-information/physician-faqs/covid-19-faqs-for-ob-gyns-obstetrics (n.d., accessed 1 February 2021).

10. Boelig RC, Saccone G, Bellussi F, et al. MFM Guidance for COVID-19. Am J Obstet Gynecol 2020; 2: 100106

11. Holcomb D, Faucher MA, Bouzid J, et al. Patient perspectives on audio-only virtual prenatal visits amidst the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic. Obstet Gynecol 2020; 136: 317–322

12. Jeganathan S, Prasannan L, Blitz MJ, et al. Adherence and acceptability of telehealth appointments for high-risk obstetrical patients during the coronavirus disease 2019 pandemic. Am J Obstet Gynecol 2020; 2: 100233

13. Madden N, Emeruwa UN, Friedman AM, et al. Telehealth uptake into prenatal care and provider attitudes during the COVID-19 pandemic in New York City: A quantitative and qualitative analysis. Am J Perinatol 2020; 37: 1005–1014

14. Peahl AF, Powell A, Berlin H, et al. Patient and provider perspectives of a new prenatal care model introduced in response to the coronavirus disease 2019 pandemic. Am J Obstet Gynecol 2021; 224: P381.E1–P381.E11

15. Shields AD, Wagner RK, Knutzen D, et al. Maintaining access to maternal fetal medicine care by telemedicine during a global pandemic. J Telemed Telecare 2022; 28: 583–594.

16. Wiegel G, Frederiksen B and Ranji U. Telemedicine and pregnancy care. Kaiser Family Foundation, https://www.kff.org/womens-health-policy/issue-brief/telemedicine-and-pregnancy-care/ (2020, accessed 15 October 2022).

17. Hill I and Burroughs E. Maternal telehealth has expanded dramatically during the COVID-19 pandemic. Urban Institute, https://www.urban.org/research/publication/maternal-telehealth-has-expanded-dramatically-during-covid-19-pandemic (2020).

18. Karavadra B, Stockl A, Prosser-Snelling E, et al. Women’s perceptions of COVID-19 and their healthcare experiences: A qualitative thematic analysis of a national survey of pregnant women in the United Kingdom. BMC Pregnancy Childbirth 2020; 20: Article number 600.

19. Sun F, Zhu J, Tao H, et al. A systematic review involving 11,187 participants evaluating the impact of COVID-19 on anxiety and depression in pregnant women. J Psychosom Obstet Gynecol 2021; 42: 91–99.

20. Bauman BL, Ko JY, Cox S, et al. Vital signs: Postpartum depressive symptoms and provider discussions about perinatal depression—United States, 2018. MMWR Morb Mortal Wkly Rep 2020; 69: 575–581.

21. Nair U, Armfield NR, Chatfield MD, et al. The effectiveness of telemedicine interventions to address maternal depression: A systematic review and meta-analysis. J Telemed Telecare 2018; 24: 639–650.

22. Smith AC, Thomas E, Snoswell CL, et al. Telehealth for global emergencies: Implications for coronavirus disease 2019 (COVID-19). J Telemed Telecare 2020; 26: 309–313.

23. Thomas EE, Haydon HM, Mehrotra A, et al. Building on the momentum: Sustaining telehealth beyond COVID-19. J Telemed Telecare 2022; 28: 301–308.