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Digital health's influence on the association between birth preference and vaginal birth

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Abstract

Background: Women's preferred mode of birth during pregnancy is predictive of their actual mode of birth. Digital prenatal care services are a promising method for educating women on mode of birth to reduce elective cesareans. This study aimed to evaluate the influence of digital health on the association between birth preference and mode of birth.

Methods: Data come from 5409 pregnant women enrolled in a digital platform for women's and family health. Multi-trajectory modeling identified trajectories of digital health usage throughout pregnancy. Adjusted logistic regression models tested associations between birth preferences and mode of birth. The modifying effect of digital health usage on the association between birth preference and mode of birth was assessed on the multiplicative scale.

Results: Four distinct trajectories of digital service usage were identified and labeled as: (1) baseline users (52%): the reference group; (2) just-in timers (16%): high usage during the third trimester; (3) learners (26%): high educational resource usage (e.g., articles and classes) throughout pregnancy; and (4) super users (6%): high usage of both education and care resources throughout pregnancy. Overall, preferred mode of birth at enrollment was predictive of actual mode of birth; however, digital health usage moderated this association, whereby super users and learners who preferred a cesarean at enrollment were more likely to deliver vaginally, compared to baseline users who preferred a cesarean.

Conclusion: For the increasing proportion of women considering an elective cesarean, education through a prenatal digital health platform may help to encourage vaginal birth and reduce cesarean births.

KEYWORDS
digital education, mode of birth, vaginal birth, woman-centered care

1 | INTRODUCTION

The rate of cesarean births has increased globally over the past 30 years.[1,2] In the United States, cesarean birth occurs in almost one in three pregnancies.[3] By 2022, the overall cesarean rate in the United States was 32.1%, including 26.3% of pregnancies among low-risk, nulliparous women, and 85.9% of parous women with a repeat cesarean.[4,5] In addition to being a major surgery, cesarean births are associated with increased maternal morbidity, mortality, and healthcare costs compared to vaginal birth.[6] Cesareans are a life-saving intervention for birthing women and are at times medically indicated. In contrast, elective cesareans are defined as cesareans in the absence of any standard medical or obstetric indications.[7] While the current rate of elective cesareans in the United States is small, approximately 2.5% of all live births, it is increasing,[7,8] and approximately 15% of pregnant people report a preference for a cesarean over a vaginal birth.[8–10] Cesarean preference is shaped by several factors, including fear of childbirth,[11,12] previous birth experience,[11] and safety concerns related to perceived pregnancy risk.[12] Furthermore, women's preferred mode of birth during pregnancy is highly predictive of their actual mode of birth[13] among both low- and high-risk womens.[14,15]

While many cesarean births are medically indicated for safety of the pregnant women and child, antenatal education designed to prepare low-risk women for birth while addressing their fears and beliefs may be effective in altering woman preferences and ultimately reducing the frequency of elective cesareans.[16] Although research indicates that maternal request for cesarean alone is likely not a key contributor to the high cesarean rates,[10] the shared decision-making process between woman and practitioner that occurs in light of one's preferences may be especially important.

In light of the association between a woman's preference and birth outcomes, this study investigates how birth preference early in pregnancy is associated with vaginal birth and how longitudinal use of a digital health platform designed to complement routine prenatal care throughout pregnancy may influence this relationship. First, we examined the association between birth preference during pregnancy and vaginal birth among individuals enrolled in a digital prenatal health platform. Similar to previous literature, we hypothesized that likelihood of a vaginal birth would be high among those who indicated a vaginal birth preference during pregnancy. Second, we assessed whether the associations between birth preference and vaginal birth differed based on the longitudinal trajectory of digital prenatal health service usage. We hypothesized that increased usage of educational materials would yield an increased likelihood of vaginal birth, even for those who originally indicated a cesarean preference during pregnancy.

2 | MATERIALS AND METHODS

2.1 | Study population

This retrospective cohort study examined the associations between birth preference and mode of birth among pregnant women enrolled in Maven. Maven offers a comprehensive digital platform designed to support women's and family health and complement routine prenatal care. Users receive free and unlimited access to Maven as an employer or health plan-sponsored benefit through their own or their partner's employer. Within the digital platform, Maven offers a variety of digital health education and support services, including access to a dedicated care advocate, an allied health professional (e.g., nurse, social worker, etc.) who serves as users' primary point of contact within the digital platform, supports the coordination of digital prenatal services, and directs users to providers and services; access to articles, videos, and live classes; and access to digital practitioner appointments with practitioners across a variety of specialties including mental health, nutrition, and physical therapy, and others. Data for this analysis included platform usage data as well as user-reported data from the enrollment questionnaire (completed during pregnancy upon enrollment in Maven) and the post-birth questionnaire (completed after birth).

Data were extracted from 14,997 employer- or health plan-sponsored Maven users who enrolled in the pregnancy track or transitioned to the pregnancy track from the fertility track between January 1, 2020, and May 27, 2022 (Figure 1). We excluded users who had not yet given birth ($n = 3901$), and users who did not complete the pregnancy enrollment and post-birth questionnaires ($n = 5684$), resulting in 5412 users who provided detail on both our primary exposure (i.e., prenatal birth preference) and outcome (i.e., mode of birth). Of those 5412 users, 3 did not have data on which trimester of pregnancy they enrolled in Maven, which was necessary for evaluating usage across pregnancy. Thus, a final analytic sample of 5409 users was selected for this analysis. All users consented to the use of their de-identified data for scientific research upon creating a Maven account. This study used de-identified data only, and the protocol was designated as exempt by the WCG Institutional Review Board.

2.2 | Birth preferences and outcomes

The primary study outcome was self-reported mode of birth and the primary exposure was self-reported birth preference. Upon Maven enrollment during pregnancy, users were asked "what type of birth are you hoping to have?" with response options of "Vaginal birth,"

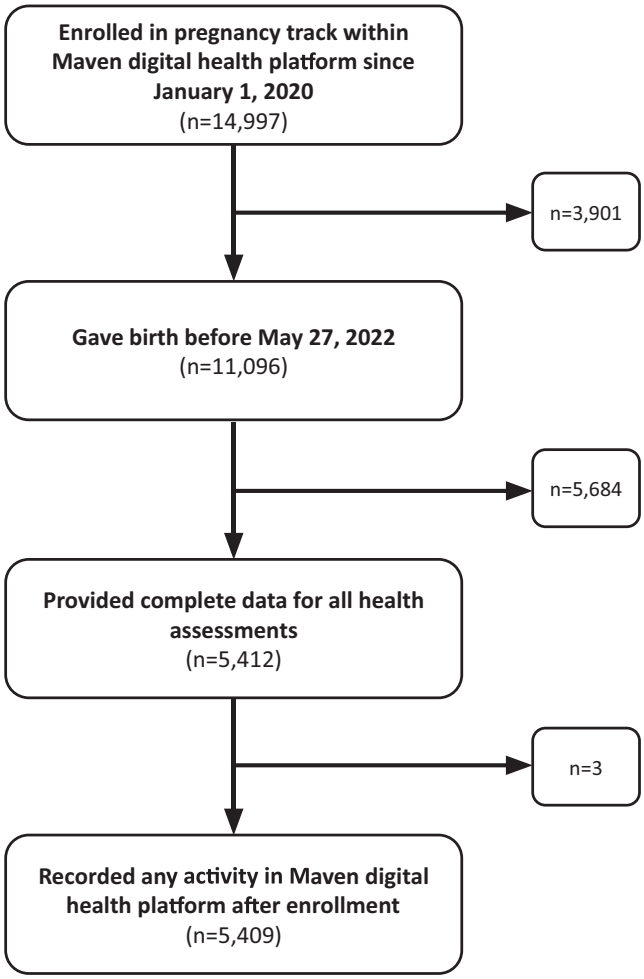

FIGURE 1 Flowchart of the users included in the current analysis.

"C-section," and "No preference." On the post-birth questionnaire, participants were asked to report their actual mode of birth. The mode of birth outcomes considered in this analysis included vaginal or cesarean birth.

2.3 | Digital health usage

Usage of Maven services was used as an effect modifier in this analysis to determine how digital health usage influences the association between birth preference and mode of birth. All usage data were tracked automatically within Maven for each user by trimester of usage based on the user's self-reported estimated due date. Tracked data included the total number of: articles read, class recordings watched, virtual classes attended live, messages sent to a care advocate, messages sent to a practitioner, and appointments with a practitioner. Users could enroll in Maven at any point during their pregnancy. Users who enrolled in their second or third trimester of pregnancy were assigned a "0" for each usage indicator in the trimester(s) before their enrollment to reflect Maven usage throughout their entire pregnancy.

To identify distinctive clusters, or trajectories, of digital health service usage throughout pregnancy, we used group-based multi-trajectory modeling (GBTM).[17] GBTM uses maximum-likelihood estimation to identify latent clusters of individuals following similar trajectories across *multiple* indicators of interest.[17–19] Therefore, we used GBTM to create our digital health usage measure, as it enabled us to evaluate usage of key digital health service indicators (i.e., articles read, class recordings watched, digital classes attended live, messages sent to a care advocate, messages sent to a practitioner, and appointments with a practitioner) across time (i.e., trimester of pregnancy). We performed the GBTM analysis using the Stata plug-in, *traj* (StataCorp, College Station, TX).[20] Our final model identified four distinct trajectories of digital service usage throughout pregnancy (Figures S1 and S2):

1. Baseline users ($n=2828$; 52%): Users who read articles and attended classes increasingly throughout pregnancy, with minimal engagement with the other services.
2. Just-in-timers ($n=876$; 16%): Users with a distinct increasing pattern seen for all usage indicators across pregnancy, with high usage during the third trimester.
3. Learners ($n=1393$; 26%): Users who read a high number of articles (compared with the other trajectories), watched class recordings, and attended live classes with minimal messaging or appointments with their care advocate or a practitioner.
4. Super users ($n=312$; 6%): Users who exhibit high usage for each indicator of interest, compared to the other trajectory groups, throughout each trimester of pregnancy.

Additional detail on the GBTM methods, results, and user characteristics associated with each usage trajectory group has been previously described (Table S1).[21]

2.4 | Covariates

During enrollment in the Maven pregnancy track, users completed an onboarding questionnaire to assess demographics (e.g., self-reported age, race, and ethnicity) and medical history (e.g., parity [live plus stillbirth], chronic conditions, pregnancy-related conditions, and mental health conditions). User-reported pre-pregnancy height and weight were used to determine pre-pregnancy body mass index (BMI). Ethnicity and race were categorized into "Hispanic/Latinx" and non-Hispanic/Latinx: "White,"

"Asian or Pacific Islander," "Black," and "Other" (due to small sample size, composed of users who identified as multiracial or American Indian). Chronic and pregnancy medical conditions were each assessed as cumulative risk scores, calculated by adding the number of medical- or pregnancy-related conditions reported by each user. The presence of mental health conditions was coded as a dichotomous variable, "yes" when users reported the presence or history of anxiety, depression, or perinatal mood disorder, and "no" when users reported no history of these conditions. Pregnancy-related anxiety was assessed on a 5-item Likert scale in response to "On a scale of 1–5, how anxious are you feeling about your pregnancy?," with responses ranging from 1 ("Not at all") to 5 ("Extremely"). Pregnancy-related anxiety was coded dichotomously as "yes" when users reported that they were feeling "4-very" or "5-extremely" anxious and "no" if users rated the item at 3 or lower. Trimester of enrollment into the digital health service was automatically tracked within Maven based on the user's self-reported estimated due date.

2.5 | Statistical methods

Descriptive statistics were used to examine demographic and medical variable distributions by birth history (i.e., nulliparous, parous with no previous cesarean, and parous with previous cesarean). Comparisons of categorical variables were performed using chi-square and Fisher's exact test. Continuous variables were compared using one-way analysis of variance.

Multivariable logistic regression was used to estimate the adjusted odds of a vaginal birth among each birth history group after adjustment for potential confounders, including the user's trimester of enrollment into the digital health service, race, ethnicity, age, pre-pregnancy body mass index, presence of chronic medical conditions, pregnancy conditions, and mental health conditions. The modifying effect of digital health usage on the association between birth preference and mode of birth was assessed on the multiplicative scale and predicted probabilities were derived from this model. All analyses were conducted using Stata 15 (StataCorp, College Station, TX). Statistical significance was set at $p < 0.05$.

3 | RESULTS

3.1 | User characteristics

Our analytic sample consisted of 5409 pregnant women enrolled in the digital health service (4028 nulliparous, 967 parous with no previous cesarean, and 414 parous with a previous cesarean). The mean age of our sample was 32.7 years (SD = 4.0). Forty-three percent of users identified as non-Hispanic white, 18% as non-Hispanic Asian or Pacific Islander, and 25% preferred not to disclose their race and ethnicity status (Table 1). The majority of users had a pre-pregnancy BMI between 18.5 and 24.9 kg/m^2 (55%), and approximately 1% of the women were pregnant with more than one baby. Relatively few users reported the presence of any chronic medical conditions, with thyroid disease being the most prevalent (8%). During pregnancy, gestational diabetes (11%) and high blood pressure (13%) were the most common pregnancy-related medical conditions reported. Mental health conditions were more frequent, with 23% and 12% of the sample reporting anxiety and depression, respectively. Most users were grouped into the baseline (52%) or learner (26%) digital health usage trajectories. Demographic differences between each digital health usage trajectory are presented in Table S1.

3.2 | Birth preference and mode of birth

During pregnancy, 81% of users reported a preference to birth vaginally, 12% reported no preference, and 6% reported that they would prefer a cesarean (Table 1). Cesarean preference was more frequent among parous women with a prior cesarean birth (54%), compared with nulliparous (3%) or parous women without a prior cesarean birth (3%). After birth, 70% of users reported having a vaginal birth. The rate of vaginal birth was significantly higher among nulliparous (71%) or parous women without a cesarean history (89%), compared with parous women with a cesarean history (18%).

Birth preference during pregnancy was significantly associated with the likelihood of vaginal birth in adjusted models (Table 2). Compared with reporting no birth preference during pregnancy, report of a vaginal birth preference was associated with an increased likelihood of a vaginal birth among nulliparous (AOR 1.54; 95% CI 1.27–1.87) and parous women with a cesarean history (AOR 2.42; 95% CI 1.04–5.61). There was no significant association between vaginal birth preference and vaginal birth among parous users without a cesarean history (AOR 6.23; 95% CI 0.99–39.1). Report of a cesarean birth preference was associated with a decreased likelihood of a vaginal birth among all users ([$AOR_{Nulliparous}$ 0.16; 95% CI 0.09–0.29], [$AOR_{Parous,\ no\ previous\ cesarean}$ 0.05; 95% CI 0.01–0.56], and [$AOR_{Parous,\ previous\ cesarean}$ 0.09; 95% CI 0.03–0.27]).

TABLE 1 Participant demographic characteristics and select baseline conditions across participant birth history.[a]

	Total ($N=5409$)	Nulliparous ($N=4028$)	Parous, no previous cesarean ($N=967$)	Parous with previous cesarean ($N=414$)	p-Value
Sociodemographic characteristics					
Age (years), mean (SD)	32.7 (4.0)	32.2 (3.9)	33.8 (3.9)	35.2 (4.2)	<0.001
Race & ethnicity					
Non-Hispanic, white	2317 (42.8)	1715 (42.6)	421 (43.5)	181 (43.7)	<0.001
Non-Hispanic, Asian, or Pacific Islander	996 (18.4)	772 (19.2)	151 (15.6)	73 (17.6)	
Non-Hispanic, black	238 (4.4)	156 (3.9)	49 (5.1)	33 (7.8)	
Non-Hispanic, American	120 (2.2)	86 (2.1)	27 (2.8)	7 (1.7)	
Indian or multiracial Hispanic	411 (7.6)	286 (7.1)	98 (10.1)	27 (6.5)	
I prefer not to say	1327 (24.5)	1013 (25.2)	221 (22.9)	93 (22.5)	
Body mass index classification (kg/m^2)					
Underweight (<18.5)	174 (3.2)	152 (3.8)	14 (1.5)	8 (1.9)	<0.001
Normal (18.5 to <25.0)	2963 (54.8)	2298 (57.1)	488 (50.5)	177 (42.8)	
Overweight (25.0 to <30.0)	1433 (26.5)	1021 (25.4)	287 (29.7)	125 (30.2)	
Obese (≥30.0)	839 (15.5)	557 (13.8)	178 (18.4)	104 (25.1)	
Multiple gestation	73 (1.4)	50 (1.2)	13 (1.3)	10 (2.4)	0.14
Birth preference					
No preference	658 (12.2)	601 (14.9)	7 (0.7)	50 (12.1)	<0.001
Vaginal	4403 (81.4)	3328 (82.6)	934 (96.6)	141 (34.1)	
Cesarean	348 (6.4)	99 (2.5)	26 (2.7)	223 (53.9)	
Birth outcome					
Vaginal	3779 (69.9)	2847 (70.7)	858 (88.7)	74 (17.9)	<0.001
Cesarean	1630 (30.1)	1181 (29.3)	109 (11.3)	340 (82.1)	
Chronic medical conditions					
Heart disease	24 (0.4)	16 (0.4)	4 (0.4)	4 (1.0)	0.24
Diabetes (type 1 or type 2)	68 (1.3)	37 (0.9)	16 (1.7)	15 (3.6)	<0.001
High blood pressure	184 (3.4)	92 (2.3)	55 (5.7)	37 (8.9)	<0.001
Blood disorder	55 (1.0)	38 (0.9)	10 (1.0)	7 (1.7)	0.31
APLA/thrombophilia	28 (0.5)	17 (0.4)	9 (0.9)	2 (0.5)	0.12
Kidney disease	13 (0.2)	10 (0.3)	2 (0.2)	1 (0.2)	1.00
Thyroid disease	435 (8.0)	294 (7.3)	92 (9.5)	49 (11.8)	0.001
Autoimmune disease	164 (3.0)	124 (3.1)	29 (3.0)	11 (2.7)	0.89
Pregnancy-related medical conditions					
Cholestasis in pregnancy	81 (1.5)	62 (1.5)	14 (1.5)	5 (1.2)	0.86
Gestational diabetes	581 (10.7)	416 (10.3)	101 (10.4)	64 (15.5)	0.01
Intrauterine growth restriction	147 (2.7)	114 (2.8)	24 (2.5)	9 (2.2)	0.65
High blood pressure	686 (12.7)	556 (13.8)	87 (9.0)	43 (10.4)	<0.001
Preeclampsia	305 (5.6)	245 (6.1)	41 (4.2)	19 (4.6)	0.05
Mental health conditions					
Pregnancy-related anxiety	611 (11.3)	464 (11.5)	95 (9.8)	52 (12.6)	0.23
Anxiety	1255 (23.2)	925 (23.0)	230 (23.8)	100 (24.2)	0.77
Depression	660 (12.2)	469 (11.6)	145 (15.0)	46 (11.1)	0.01
Perinatal mood disorder	84 (1.6)	57 (1.4)	16 (1.7)	11 (2.7)	0.15

(Continues)

TABLE 1 (Continued)

	Total ($N=5409$)	Nulliparous ($N=4028$)	Parous, no previous cesarean ($N=967$)	Parous with previous cesarean ($N=414$)	p-Value
Digital health usage					
Trimester of digital health platform enrollment					
First	1418 (26.2)	1107 (27.5)	216 (22.3)	95 (23.0)	<0.001
Second	2323 (43.0)	1755 (43.6)	400 (41.4)	168 (40.6)	
Third	1668 (30.8)	1166 (29.0)	351 (36.3)	151 (36.5)	
Digital health usage trajectory[b]					
Baseline	2828 (52.3)	1862 (46.2)	684 (70.7)	282 (68.1)	<0.001
Just-in-timer	876 (16.2)	708 (17.6)	108 (11.2)	60 (14.5)	
Learner	1393 (25.8)	1190 (29.5)	148 (15.3)	55 (13.3)	
Super user	312 (5.8)	268 (6.7)	27 (2.8)	17 (4.1)	

[a]Unless otherwise indicated, data are no. (%). Data are displayed for users who enrolled in Maven Clinic and gave birth between January 1, 2020, and May 27, 2022.

[b]Digital health usage trajectory determined through multi-trajectory analysis.[21]

3.3 | Modifying influence of digital health usage

Figure 2 displays where the influence of digital health usage on the associations between birth preference and mode of birth were significant (the full results for all of the significant [$p<0.05$] and non-significant associations [$p\geq0.05$] are presented in Table S2). Within the whole sample, among users who reported a cesarean preference during pregnancy, learners and super users had a statistically significant increased predicted probability of vaginal birth compared with baseline users ([$AOR_{Learners}$ 6.70; 95% CI 2.36–19.05; $p<0.001$], [$AOR_{Super\ Users}$ 5.92; 95% CI 1.17–29.85; $p=0.03$]; Figure 2A). Among nulliparous women who preferred a cesarean birth during pregnancy, learners had a statistically significant increased predicted probability of vaginal birth compared with baseline users ([AOR = 4.20, 95% CI 1.16–15.17; $p=0.03$]; Figure 2B). There were no significant interaction effects of birth preference and digital health usage among parous women who previously had a cesarean or parous women who previously had a vaginal birth.

4 | DISCUSSION

This retrospective cohort study examined the association between birth preference and mode of birth among pregnant women enrolled in Maven, a digital health platform. First, our multivariate analyses suggested that birth preference during pregnancy was associated with mode of birth across all women. Second, we show usage of Maven moderated the association between birth preference and mode of birth for the most engaged users.

Consistent with previous studies,[13,14] this analysis identified an association between birth preference during pregnancy and mode of birth. Even after stratification by birth history and adjustment for relevant clinical and sociodemographic characteristics, preference for a cesarean during pregnancy was associated with a decreased likelihood of a vaginal birth. The process by which birth preference affects actual mode of birth is unknown. One proposed, albeit debated, mechanism within the literature suggests maternal preference leads to a maternal request for cesarean which ultimately contributes to an increased likelihood of a cesarean.[16,22] While relatively few pregnant women actually prefer a cesarean birth (approximately 21.3% of pregnant women in North America according to a meta-analysis[10]), cesarean rates in the United States remain high (31.8%)[23] and influence on a woman's preference for this population may be a key targeted lever to reduce unnecessary cesareans.

Our analysis of digital health usage found that among those who reported a cesarean preference, increased usage of a prenatal digital healthcare platform was associated with an increased likelihood of vaginal birth. Compared to those with low digital health usage, women who were classified as “Learners” (i.e., high usage of educational articles, virtual classes, and class recordings throughout pregnancy) and “Super Users” (i.e., high usage across all resources in the digital health platform throughout pregnancy) had an increased likelihood of vaginal birth, even when they had previously reported a cesarean preference. Our results indicate digital health tools, like Maven, may contribute to lower cesarean rates through increased

TABLE 2 Associations between birth preference and likelihood of vaginal birth.[a]

	Vaginal birth whole sample		Vaginal birth nulliparous users		Vaginal birth parous users no previous cesarean		Vaginal birth parous users previous cesarean	
	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Birth preference								
No preference	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Vaginal birth preference	2.38 (2.01, 2.82)	2.12 (1.77, 2.53)	1.82 (1.51, 2.18)	1.54 (1.27, 1.87)	7.79 (1.71, 35.42)	6.23 (0.99, 39.05)	2.80 (1.29, 6.04)	2.42 (1.04, 5.61)
Cesarean birth preference	0.06 (0.04, 0.09)	0.06 (0.04, 0.10)	0.13 (0.08, 0.23)	0.16 (0.09, 0.29)	0.06 (0.01, 0.50)	0.05 (0.01, 0.56)	0.11 (0.04, 0.32)	0.09 (0.03, 0.27)

Abbreviation: 95% CI, 95% confidence interval.

[a]Model adjusted for trimester of enrollment into the digital health service, maternal race, ethnicity, age, pre-pregnancy body mass index, multiple gestation, presence of chronic medical conditions, pregnancy conditions, and mental health conditions.

access to birth planning classes, increased practitioner interaction, and educational materials. This finding supports the World Health Organization's recommendations to reduce unnecessary cesarean sections through non-clinical educational interventions.[24] While we recognize digital health resources will not affect everyone's birth preferences, our results suggest that for a proportion of individuals, digital health tools may be effective.

After stratification by birth history, the interaction between digital health usage and birth preference was not significantly associated with the likelihood of a vaginal birth among parous women. This finding may reflect the strong association among birth history, subsequent birth preference, and mode of birth.[23,25] While nationally the preference for a subsequent cesarean is common, with only 22% of women attempting a trial of labor after cesarean (TOLAC),[26] in our analytic sample, 34.1% of users with a history of cesarean reported a preference for a vaginal birth (Table 1), and of those, 41% had a vaginal birth (data not shown; usage of Maven has been associated with an increase in rates of vaginal birth after cesarean[27]).

Usage of digital health tools during pregnancy presents a potential path to decrease cesarean rates in the United States. It is estimated that 2.5% of all births in the United States are cesarean delivery on maternal request.[7] In 2022, individuals in the United States gave birth to 3,745,361 million infants.[28] Thus, while 2.5% appears to comprise a small number of births, a significant decrease in cesarean delivery on maternal request could affect almost 100,000 births per year. Furthermore, we found a significant influence of digital health usage on birth outcomes for nulliparous women. A key contributor to high cesarean rates results from previous cesareans performed among nulliparous women, which increases risk of cesarean in subsequent pregnancies.[29] Reduction in nulliparous cesarean birth rates could yield significant reductions in cesarean rates over time as women continue through subsequent pregnancies. To further the influence of digital health on mode of birth, future research should consider which particular educational resources and types of resources are most engaging and effective in providing information for birth planning. Additional research is needed on woman–practitioner interactions during pregnancy to fully elucidate the complex, dynamic mechanisms between woman's preference and mode of birth.

4.1 | Strengths and limitations

A major strength of this study was the large sample size from a national cohort. Furthermore, this study details data on user-reported pregnancy preferences and

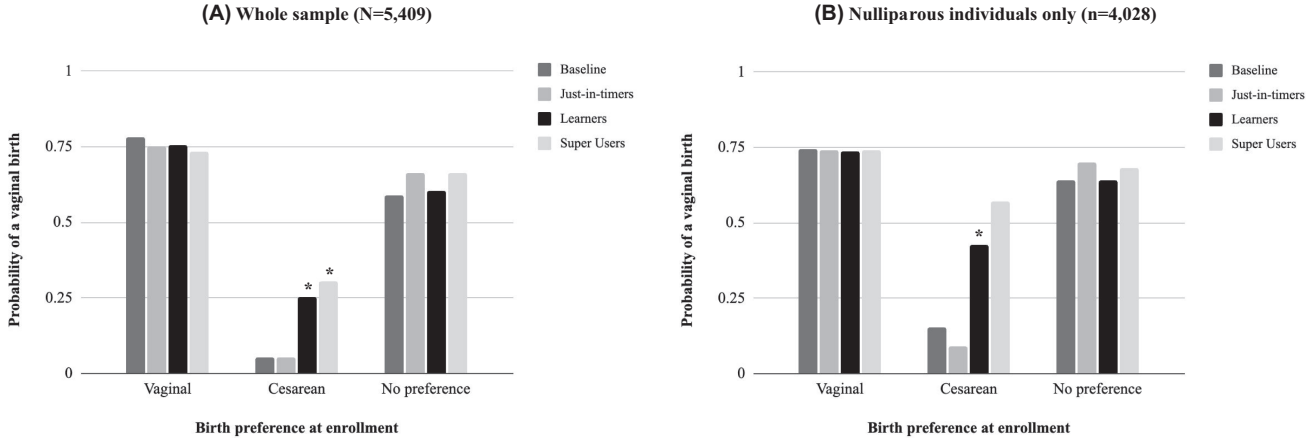

FIGURE 2 Digital health usage moderates the association between birth preference and predicted probability of a vaginal birth. *$p < 0.05$. *Note*: Probabilities adjusted for trimester of enrollment into the digital health service, maternal race, ethnicity, age, pre-pregnancy body mass index, multiple gestation, presence of chronic medical conditions, pregnancy conditions, and mental health conditions. (A) Among those who preferred a cesarean birth during pregnancy, learners (AOR = 5.62; 95% CI 1.98–15.91; $p = 0.001$) and super users (AOR = 5.57; 95% CI 1.12–27.57; $p = 0.04$) had a statistically significant increased predicted probability of vaginal birth compared with baseline users. (B) Among nulliparous women who preferred a cesarean birth during pregnancy, learners had a statistically significant increased predicted probability of vaginal birth compared with baseline users (AOR = 4.11; 95% CI 1.09–15.53; $p = 0.04$).

outcomes. Unique to other birth preference studies, we used multi-trajectory modeling to evaluate the longitudinal impact of digital health usage on mode of birth. This nuanced approach enabled us to characterize the overall digital health usage *throughout* pregnancy, versus relying on a single indicator of usage. Furthermore, this study extends the literature on birth preference by identifying a potential pathway through which woman-centered, digital educational tools may be used to reduce unnecessary cesarean births.

This study has several limitations. First, the study was limited by restricting our analytic sample to those who self-reported their demographic and birth preference information upon enrollment into the digital health platform and their mode of birth after birth. As a result, the analysis may be subject to reporting bias. Second, birth preference data was collected once during pregnancy upon enrollment into the digital healthcare platform. Individuals were able to enroll in Maven at any point during their pregnancy. Our cross-sectional analysis of birth preference limited our ability to evaluate initial reasons for a specified birth preference (i.e., obstetrical reasons or birth history), or any preference changes during pregnancy. Third, there are several institutional- and individual-level factors associated with birth outcomes that we did not evaluate in this analysis. Access to TOLAC is limited in many areas and may influence one's birth preference, as well as their birth outcome.[30] Furthermore, our analysis only evaluated birth preference, not strength of the preference. Strength of preference has been positively correlated with mode of birth,[14] and may provide further insight into our results. Last, our study population consisted of commercially insured individuals, who had access to the internet. The majority identified as white and non-Hispanic, potentially limiting the generalizability of these findings.

5 | CONCLUSIONS

This study found that, although few pregnant women preferred cesarean birth, those who did had a decreased likelihood of a vaginal birth. High usage of a digital healthcare platform modified this relationship, whereby increased digital health usage among those who preferred a cesarean during pregnancy were more likely to deliver vaginally than baseline users who preferred cesarean. While increased opportunities for woman education may offer one pathway to cesarean birth reduction, given the various institutional- and individual-level factors that contribute to cesarean birth in the United States, there is not going to be one single solution to reduce the cesarean rate. Instead, different strategies will need to be tailored to various populations and individuals. Our findings indicate that digital, woman-centered educational tools may provide a pathway for elective cesarean reduction.

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DATA AVAILABILITY STATEMENT

Research data are not shared.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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