User profile and preferences in fertility apps for preventing pregnancy: an exploratory pilot study

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Background: The rapid proliferation of fertility apps has created a market that has the potential to address the needs of women and couples worldwide. Some women who seek to prevent pregnancy are making behavioral decisions based on information they receive from fertility apps, yet fertility apps may not always be accurate and reliance on them could lead to unintended pregnancies. Little research has been done to understand who uses fertility apps for pregnancy prevention, how those who use them perceive their efficacy, and their preferences for how apps should be designed and presented to accurately assist them in preventing pregnancy.

Methods: A web-based pilot survey was launched through Facebook recruiting women who either currently use a fertility app for pregnancy prevention or intend to use one in the future. Data collected from 1,000 women surveyed user preferences around fertility app characteristics, including aesthetics, features, functionality, and reputation. User knowledge about fertility and reproduction was assessed, and knowledge categories were created. Chi-square tests assessed differences in app characteristic preferences according to knowledge category. Additional qualitative analyses on free-text answers explored which features of apps are important to users when they search for one to use.

Results: Approximately one quarter (23.1%) of survey respondents reported currently using a fertility app or had used one in the recent past, and 76.9% reported intention to use one in the future. A majority of both current and intended users (65.4%) had some knowledge of fertility and reproduction, while 16.5% had very little knowledge. 18.1% reported receiving prior provider counseling on using a fertility-awareness based method. Users across all knowledge groups said it was very important for apps to be science-based and that they identify fertile days during the menstrual cycle.

Conclusions: Women who use or wish to use apps to prevent pregnancy are seeking apps that are scientifically sound and provide them personalized information around their potential fertility. However, most fertility apps women reported using lack the capability for true fertility-awareness based method application for accurate, reliable pregnancy prevention. More research is needed to evaluate apps for efficacy and accuracy preventing pregnancy. Collaborations between app developers and women's health experts are encouraged, as well as informed consumerism campaigns.

Keywords: Health tracking; pregnancy prevention; fertility awareness; menstrual cycle

Received: 27 March 2018; Accepted: 30 May 2018; Published: 30 June 2018.

doi: 10.21037/mhealth.2018.06.02

View this article at: http://dx.doi.org/10.21037/mhealth.2018.06.02

Introduction

Tracking health behaviors using mobile apps and devices offers timely, relevant data to help users gain self-knowledge for monitoring, and even changing, their behavior, with applications ranging from reminders about getting vaccinations to monitoring mental health status (1,2). Self-tracking for health is extremely popular: more than 70% of U.S. adults track or self-monitor a personal health indicator using a digital app (3). Market trends forecast the self-monitoring technologies market to exceed $18B in 2019, as evidenced by growing popularity for wearable technologies and self-monitoring apps (4).

Using tracking apps for menstrual and fertility monitoring is a progressive approach to tailored personal informatics. "Fertility apps" have gained momentum across all age groups and are the fourth most popular health monitoring apps among adults and the second most popular among adolescent girls (5). Fertility apps can assist women in preventing a pregnancy or conceiving. Many are marketed as digital extensions of fertility awareness-based methods (FABM), an evidence-based branch of contraception that relies on women identifying fertility through the interpretation of physiological signs and/or tracking of cycle lengths. Fertility apps on mobile phones provide information about women's fertility status (whether they are likely to get pregnant if they have unprotected intercourse that day) and can help women keep track of menstrual cycles, estimate fertile days and ovulation, and integrate digital reminders or notifications for monitoring. Dozens of fertility apps are available and are typically branded as offering sophisticated data analytic approaches to predict key reproductive metrics with greater accuracy than traditional forms of self-tracking (6). However, a recent study found that only 30 currently existing apps purport to predict fertile days for a user, and of those apps only 6 were found to accurately identify the fertile window (7). The lack of accuracy is of particular importance to women using fertility apps to prevent a pregnancy, as the incorrect information provided around the fertile window can inform behavior that can lead to unintended pregnancy.

Very little is known about women using fertility apps specifically for pregnancy prevention. For example, it is unclear whether women use apps as a replacement for scientifically-validated FABM, in conjunction with other methods of birth control such as barrier methods, or simply to improve fertility self-knowledge. In addition to motivations for using fertility apps, gaps exist in our understanding about what garners trust in fertility apps for pregnancy prevention. Internet research studies have consistently identified trust as a key ingredient in whether an online resource may influence health-related behaviors (8-13). Users may trust apps' ability to help them navigate health decisions if app design, including aesthetics (14) and functionality (15), is attractive to users, and if the app is reputable (16,17). Without understanding the characteristics and perceptions of this population, it is difficult to develop strategies to improve consumer behavior.

In this exploratory pilot study, we aim to identify women who currently use or intend to use a fertility app specifically to prevent pregnancy, and explore their preferences and perceptions about using apps for this purpose.

Methods

Recruitment

Women aged 18–39 were invited to participate in an online survey administered by Lab42[1] about their use and preferences using a fertility app. Users were eligible to participate if they were over the age of 18 and reported either having used an app to prevent pregnancy or their intention to use an app to prevent pregnancy in the future. Lab42 recruited women through Facebook between November 29 and December 8, 2016.

All participants verified their age and gave informed consent for participation in the study. Survey participants were incentivized with points, credits, or loyalty rewards for sites through which they took the survey. Data was downloaded from Facebook and stored in a secure database. Lab42 read all open-ended responses to ensure the respondent provided thoughtful and useful information. If a respondent did not pass their manual data quality inspection, Lab42 re-fielded and collected an additional sample.

Survey

We collected data about interest in and current use of fertility apps, as well as user intentions and goals for using fertility apps for pregnancy prevention. The survey included three questions to assess their level of basic knowledge

[1] Lab42 is a market research firm.

Table 1 Attraction, functionality, and reputation survey questions, scales, and items

Type of app characteristic	Survey question	Scale	Items
Attraction	Please rate each of the following items on how important they are to you in deciding whether to use an app to prevent pregnancy	1 (not at all important) to 5 (very important)	(I) Aesthetics/look of the app
			(II) User ratings and reviews
			(III) Easy to navigate
			(IV) Based on proven, scientific evidence
			(V) Cost
			(VI) Word of mouth/personal recommendations
Functionality	Please rate how important different features of an app designed for pregnancy prevention are/would be important for you	1 (not at all important) to 5 (very important)	(I) Shows my when I'm ovulating
			(II) Estimates the days when I am most likely to get pregnant
			(III) Tracks my menstrual cycle
			(IV) Allows me to input my temperature or cervical secretions
			(V) Allows me to put in my own notes about my health
			(VI) Allows me to notify my partner when I'm fertile
			(VII) Offers community support
			(VIII) Keeps my information private and doesn't share it with outside parties
			(IX) Connects with my other health apps
			(X) Allows me to share data with my healthcare provider
Reputation	Please rank, by order of importance, which of these types of evidence are/would be most important for you when selecting an app to prevent pregnancy	Ranking	(I) An app that a healthcare provider recommended
			(II) An app that had published research conducted on it
			(III) A recommendation from a family member or friend
			(IV) An app that was highly rated in the app store
			(V) An app that was recommended by a government or nonprofit group
			(VI) An app that was recommended in a news article or blog post

about fertility and the reproductive cycle. Respondents were also asked to rate 6 app features that appeal to them in selecting an app to assist them in preventing pregnancy (*attraction*); rate specific app functions to assist users with pregnancy prevention (*functionality*), and rank which types of evidence were the most important to them personally in selecting an app to prevent pregnancy (*reputation*). See *Table 1* for questions, scale, and item details. Women could also indicate if they had ever received some form of counseling from a provider on FABM. Responses about provider FABM counseling did not indicate parameters, depth, or quality of provider counseling.

Most survey questions consisted of 5-point response scales. Due to few responses, those who selected "Not at all important" and "Low Importance" on importance questions were collapsed into a single category. For the survey question asking respondents to rank items by order of importance, rankings were grouped into top-ranked (rank 1 or 2), middle-ranked (rank 3 or 4), or low-ranked (rank 5 or 6).

Respondents also entered free-text examples of search terms they would use to search and find apps.

Fertility knowledge scales

Responses to survey knowledge questions about the menstrual cycle and fertility were assessed for accuracy. Survey items used were "What is considered the first day of a woman's menstrual cycle?" and was considered correctly answered as "The first day of her period (bleeding);" "True or False: A woman can get pregnant at any time in her cycle," correctly answered as "False;" and "What days in the menstrual cycle is a woman most likely to become pregnant?" correctly answered as "For a few days about halfway between two periods." "Other" write-in responses to the third item were also coded for accuracy.

Respondents were grouped into two categories based on the proportion of knowledge questions they answered accurately: respondents with "moderate knowledge" answered any of the three knowledge items correctly; respondents with "limited knowledge" answered zero of the 3 correctly. Respondents who indicated they had received any form of counseling from a provider on FABM comprised a third group. We assessed this third self-reported provider-counseled group separately. Our hypothesis was that provider counseling on FABM would indicate the participant was more knowledgeable about fertility, and may be differently motivated than other fertility app users.

Statistical analysis

To examine the relationship between the provider-trained group and scoring on the knowledge items, chi-square tests were conducted to test for independence of the accuracy of responses to knowledge questions and whether a respondent had received training or counseling in FABM from a provider. Chi-square tests were then used to test for independence of the groupings and how users rated attraction and functionality and ranked types of evidence. The adjusted residuals were calculated to determine where the largest differences between observed and expected counts arose, while accounting for sample size of each of the three respondent groups. Statistical analyses were conducted in Stata v. 15 (StataCorp LLC; College Station, TX).

Qualitative analysis

Free-text search terms were extracted and collated for qualitative content analysis (18). Content analysis of app search terms is an emerging facet of analysis for web-based qualitative data, and is an appropriate approach to explore user intentions to find apps that match their preferences and desires (19). Using MaxQDA (v.2018), all search terms were assessed for content, frequency, and reading level. Differences in search terms according to user groupings were explored. Codes were constructed based on keywords and phrases that appeared most often within search terms. All data was coded and interpreted for content meanings.

Results

User statistics

One thousand (1,000) eligible female users completed the survey: 654 "moderate knowledge" users, 165 "limited knowledge" users, and 181 users who reported some form of provider counseling. Approximately 77% of respondents (n=769) indicated interest in using an app to prevent pregnancy in the future, while 23% (n=231) said they have used or currently use an app for this purpose. The majority of current app users reported that they had used Period Tracker (53.7%); other reported apps used included Fertility Calendar (26.0%), Fertility Friend (11.7%), Natural Cycles (11.3%), Ovia (7.4%), Ovuline (7.4%), Glow (6.9%), Dot (6.5%), Pink Pad Pro (6.5%), OvaGraph (6.1%), Kindara (5.2%), iCycleBeads (4.3%), Conceivable (3.9%), Clue (3.0%), 2DayMethod (3.0%) and unnamed others (9%).

About a quarter of current fertility app users reported they were "very confident" that the app they used would help them avoid pregnancy (23.8%); 46.3% were somewhat confident and another quarter (23.4%) were not sure. Among those who intended to use a fertility app in the future, nearly half (43.6%) were not sure if an app could help them successfully avoid pregnancy; one third (34.6%) were somewhat confident and 10.3% were very confident.

The age distribution of users with moderate knowledge was similar to the sample as a whole, while users with limited knowledge were slightly older. A higher percentage of women reporting provider training were between 18–24 years old (*Table 2*). The majority of survey respondents identified as Caucasian/White (74.1%), while 7.6% reported being Hispanic/Latino, 7.5% African American/Black, and 6.6% Asian. Of all respondents, 71.5% identified as either married, living with their significant other, engaged, or dating, while 25.4% reported being single. *Table 2* summarizes our complete demographic results by

Table 2 Demographics by user group

Variable	Category	Limited knowledge (n=165) (%)	Some knowledge (n=654) (%)	Provider-counseled (n=181) (%)	Total (N=1,000) (%)
Age range	18–24	65 (39.39)	160 (24.46)	32 (17.68)	257 (25.7)
	25–29	31 (18.79)	177 (27.06)	44 (24.31)	252 (25.2)
	30–34	43 (26.06)	160 (24.46)	47 (25.97)	250 (25.0)
	35–39	26 (15.76)	157 (24.01)	58 (32.04)	241 (24.1)
Race/ethnicity	Caucasian/White	124 (75.15)	485 (74.16)	132 (72.93)	741 (74.1)
	Hispanic/Latino	11 (6.67)	50 (7.65)	15 (8.29)	76 (7.6)
	African American/Black	12 (7.27)	49 (7.49)	14 (7.73)	75 (7.5)
	Asian	13 (7.88)	44 (6.73)	9 (4.97)	66 (6.6)
	Native American	1 (0.61)	5 (0.76)	5 (2.76)	11 (1.1)
	Other/undisclosed	4 (2.43)	21 (3.21)	6 (3.32)	31 (3.1)
Relationship status	Married/civil union	49 (29.7)	240 (36.69)	79 (43.64)	368 (36.8)
	Partnered/dating	64 (38.78)	224 (34.25)	59 (32.59)	347 (34.7)
	Single	46 (27.88)	171 (26.15)	37 (20.44)	254 (25.4)
	Divorced/separated/ widowed	6 (3.64)	19 (2.90)	6 (3.31)	31 (3.1)
Employment status	Employed full time	53 (32.12)	276 (42.2)	74 (40.88)	403 (40.3)
	Employed part time	19 (11.52)	80 (12.23)	23 (12.71)	122 (12.2)
	Unemployed	20 (12.12)	48 (7.34)	12 (6.63)	80 (8.0)
	Homemaker	29 (17.58)	131 (20.03)	45 (24.86)	205 (20.5)
	Other	44 (26.66)	119 (18.20)	27 (14.91)	190 (19.0)
Annual household income	Under $25,000	43 (26.06)	126 (19.27)	47 (25.97)	216 (21.6)
	$25,000–$49,999	55 (33.33)	224 (34.25)	47 (25.97)	326 (32.6)
	$50,000–$99,999	42 (25.45)	189 (28.9)	56 (30.94)	287 (28.7)
	$100,000 or more	16 (9.7)	83 (12.69)	27 (14.91)	126 (12.6)
	Prefer not to answer	9 (5.45)	32 (4.89)	4 (2.21)	45 (4.5)

user group.

Of the 181 users who reported provider counseling, 80.1% had some knowledge of fertility awareness and 19.9% did not score any of the knowledge questions correctly. Overall, users who reported provider counseling on FABM were not more knowledgeable about fertility or basic reproductive health. Accuracy of the knowledge items in the survey was independent of whether a user reported having been personally counseled by a provider on FABM.

Fertility knowledge impacts on app selection and user preferences

Attraction

Users across all categories (63.4%) ranked an app being "based on proven scientific evidence" as "highly" important to them when choosing an app. A majority of users across all categories also placed "user ratings and reviews" (81.4%), "app cost" (80.4%), and "word of mouth/reputation" (68.4%) as either "Somewhat" or "Very important" to them when choosing an app. No differences were observed

between users in different knowledge categories for these three aspects of app attraction.

Aesthetics of an app were less important to users with limited knowledge, but more important to provider-counseled users (P<0.001) compared to users with moderate knowledge. A greater proportion of users with limited fertility knowledge indicated that ease of use of an app was neither important nor unimportant to them in their app selection process, compared to other user groups (P<0.001). *Table 3* provides full reporting on how user groups characterize aspects of attraction for selecting apps.

Functionality

Overall, women who reported some form of provider counseling on FABM were more likely to report app features/functions as very important compared to users with either moderate or limited knowledge for 7 out of 10 items. The three functionality aspects with no significant differences between groups were also reported as "Very Important" to a large proportion of respondents across categories, including: (I) an app that "show[s] me when I'm ovulating" (90.7%); (II) an app that "track[s] my menstrual cycle" (89.8%); and (III) an app that "keeps my information private and doesn't share it with outside parties" (78.9%).

Users in all groups indicated that an app that "estimates days I'm most likely to get pregnant" was very important (72.6%), although a significantly greater proportion of provider-counseled users indicated that this function was very important compared to other groups (80.7%, P=0.006). Fertility apps that "allow me to notify my partner when I'm fertile" were not as important for users with moderate fertility knowledge compared to users who had received provider counseling (P=0.001). Apps that "offer community support" and "allow me to share data with my healthcare provider" were also not as important to moderately knowledgeable users when compared to provider-counseled and limited knowledge users (P=0.001 and P<0.001, respectively). Users reporting provider counseling placed differential importance on apps that "allow me to input my temperature or cervical secretions" (P=0.04) and "allow me to put in my own notes about my health" (P=0.035) compared to the other groups.

Table 4 further details user group preferences for fertility app functions.

Reputation

Apps that "a healthcare provider recommended" were ranked "Very Important" for a large majority of users in both knowledge groups (70.0%), but were less important for selecting an app among users reporting provider counseling (P=0.006). Apps that "had published research conducted on it" was also highly important to many users; 54% of all users ranked it as "Very Important." Users generally ranked apps that were "recommended in a news articles or blog post" and those "recommended by a government or nonprofit group" the lowest of the six reputational app influencers.

Table 5 summarizes how users ranked reputational aspects of apps.

Search terms

A total of 1,388 discreet search terms were recorded. In aggregate, terms scored a 28.4 on the Flesch Reading Ease scale, representing a Grade 9.9 reading level. "Pregnancy" (14.72% of all words) and "tracker" (8.85%) were the two most common words used across all search terms. "Pregnancy prevention," "period tracker," "prevent pregnancy," "birth control," and "fertility tracker" were the five most common combined search terms.

The majority of search terms (71.5%) contained keywords or phrases indicating an interest in finding apps to help prevent pregnancy generally (n=405), apps that focus on the experience of menstruating or having a period (n=301), and apps focused on fertility generally (n=174). Terms indicating a desire to locate apps with the specific functionality to track ovulation (n=96) comprised 7.8% of all terms. Users also keyed terms indicating a desire to find apps focused on reminders to take birth control (7.2%); FABM specific methods (e.g., "billings") (2.0%); planning a pregnancy (not preventing) (2.0%); non-FABM of contraception (e.g., "plan b," "pill reminder app") (1.8%); women's health (0.9%); and advice on timing of sexual intercourse or safer sex (e.g., "safe times to have sex") (0.7%). In addition, 41 terms included places on the Internet or search engines they would consult to find apps, and 31 terms indicated the user did not know what to search for to find an app. Differences in search term themes between user groups were not identified.

Table 6 details search term analysis and results.

Sensitivity analysis

Our sample included women who have used or currently use fertility apps to prevent pregnancy as well as women who were interested in doing so in the future. In our analysis, we combined these two response groups (n=1,000)

Table 3 Importance of attraction aspects of an app by user group

Survey item	Limited knowledge (%)	Some knowledge (%)	Provider-counseled (%)	Total (%)	Chi-square statistic (df); P value
Aesthetics					$\chi^2(6)$ =25.5841; P<0.001
Not important	20	21.1	20.4	20.8	
Neutral	*40*[†]	28.4	23.2	29.4	
Somewhat important	30.3	36.9	*32*	34.9	
Very important	*9.7*	13.6	*24.3*	14.9	
Total	100	100	100	100	
User ratings & reviews					$\chi^2(6)$ =4.2961; P=0.637
Not important	4.2	4.1	3.9	4.1	
Neutral	14.5	13.8	17.1	14.5	
Somewhat important	46.7	40.8	38.1	41.3	
Very important	34.5	41.3	40.9	40.1	
Total	100	100	100	100	
Easy to navigate					$\chi^2(6)$ =13.2764; P=0.039
Not important	2.4	2.3	5	2.8	
Neutral	7.9	6.6	7.2	6.9	
Somewhat important	*43*	33.3	28.2	34	
Very important	*46.7*	57.8	59.7	56.3	
Total	100	100	100	100	
Based on proven, scientific evidence					$\chi^2(6)$ =14.1816; P=0.028
Not important	1.2	1.5	*5.5*	2.2	
Neutral	7.3	7.8	11	8.3	
Somewhat important	27.3	26.3	24.3	26.1	
Very important	64.2	64.4	59.1	63.4	
Total	100	100	100	100	
Cost					$\chi^2(6)$ =2.5218; P=0.866
Not important	7.3	5.5	6.1	5.9	
Neutral	15.8	13.1	13.8	13.7	
Somewhat important	29.7	33	29.3	31.8	
Very important	47.3	48.3	50.8	48.6	
Total	100	100	100	100	
Word of mouth/personal recommendations					$\chi^2(6)$ =11.8012; P=0.067
Not important	10.3	10.1	6.1	9.4	
Neutral	23.6	22.3	20.4	22.2	
Somewhat important	44.8	42.7	38.1	42.2	
Very important	21.2	24.9	35.4	26.2	
Total	100	100	100	100	

[†], italic values indicate statistically significant difference between observed and expected frequencies based on adjusted residuals.

Table 4 Importance of functional aspects of an app by user group

Survey item	Limited knowledge (%)	Some knowledge (%)	Provider-counseled (%)	Total (%)	Chi-square statistic (df); P value
Shows me when I am ovulating					$\chi^2(6)$ =11.8839; P=0.065
Not important	3	1.8	4.4	2.5	
Neutral	7.3	6.6	7.2	6.8	
Somewhat important	30.3	23.5	17.7	23.6	
Very important	59.4	68	70.7	67.1	
Total	100	100	100	100	
Estimates the days when I am most likely to get pregnant					$\chi^2(6)$ =18.0490; P=0.006
Not important	4.2	*1.5*[†]	3.9	2.4	
Neutral	7.3	6.1	5.5	6.2	
Somewhat important	21.2	*20.6*	*9.9*	18.8	
Very important	67.3	71.7	*80.7*	72.6	
Total	100	100	100	100	
Tracks my menstrual cycle					$\chi^2(6)$ =4.9797; P=0.546
Not important	4.2	2.6	3.3	3	
Neutral	6.7	7.3	7.2	7.2	
Somewhat important	29.7	23.1	23.2	24.2	
Very important	59.4	67	66.3	65.6	
Total	100	100	100	100	
Allows me to input my temperature or cervical secretions					$\chi^2(6)$ =13.1734; P=0.040
Not important	19.4	15.1	12.7	15.4	
Neutral	25.5	25.5	20.4	24.6	
Somewhat important	35.8	37	33.7	36.2	
Very important	19.4	22.3	*33.1*	23.8	
Total	100	100	100	100	
Allows me to put in my own notes about my health					$\chi^2(6)$ =13.5658; P=0.035
Not important	6.7	6.6	5.5	6.4	
Neutral	15.2	17.9	14.4	16.8	
Somewhat important	44.2	42.2	*32.6*	40.8	
Very important	33.9	*33.3*	*47.5*	36	
Total	100	100	100	100	

Table 4 (*continued*)

Table 4 (*continued*)

Survey item	Limited knowledge (%)	Some knowledge (%)	Provider-counseled (%)	Total (%)	Chi-square statistic (df); P value
Allows me to notify my partner when I'm fertile					$\chi^2(6)$ =21.7555; P=0.001
Not important	23	*25.5*	*16.6*	23.5	
Neutral	21.2	*23.1*	*13.8*	21.1	
Somewhat important	27.9	25.4	29.3	26.5	
Very important	27.9	*26*	*40.3*	28.9	
Total	100	100	100	100	
Offers community support					$\chi^2(6)$ =22.4325; P=0.001
Not important	30.9	31.7	25.4	30.4	
Neutral	30.9	31	24.9	29.9	
Somewhat important	28.5	24.8	24.9	25.4	
Very important	9.7	*12.5*	*24.9*	14.3	
Total	100	100	100	100	
Keeps my information private and doesn't share it with outside parties					$\chi^2(6)$ =10.8441; P=0.093
Not important	2.4	1.5	3.3	2	
Neutral	3.6	4.4	9.4	5.2	
Somewhat important	14.5	14.1	12.7	13.9	
Very important	79.4	80	74.6	78.9	
Total	100	100	100	100	
Connects with my other health apps					$\chi^2(6)$ =15.4467; P=0.017
Not important	22.4	24	21	23.2	
Neutral	29.7	*32.1*	*21.5*	29.8	
Somewhat important	33.9	29.4	33.7	30.9	
Very important	13.9	14.5	*23.8*	16.1	
Total	100	100	100	100	
Allows me to share my data with my healthcare provider					$\chi^2(6)$ =25.3129; P<0.001
Not important	13.3	*20.2*	16.6	18.4	
Neutral	18.8	*21.7*	*13.8*	19.8	
Somewhat important	40	34.9	29.8	34.8	
Very important	27.9	*23.2*	*39.8*	27	
Total	100	100	100	100	

[†], italic values indicate statistically significant difference between observed and expected frequencies based on adjusted residuals.

Table 5 Ranking of reputational aspects of an app by user group

Survey item	Limited knowledge (%)	Some knowledge (%)	Provider-counseled (%)	Total (%)	Chi-square statistic (df); P value
A recommendation from a family member or friend					$\chi^2(4)$ =7.3555; P=0.118
1st or 2nd	26.1	26.6	34.8	28	
3rd or 4th	48.5	43	37.6	42.9	
5th or 6th	25.5	30.4	27.6	29.1	
Total	100	100	100	100	
An app that was highly rated in the app store					$\chi^2(4)$ =8.7137; P=0.069
1st or 2nd	15.2	23.2	24.9	22.2	
3rd or 4th	31.5	34.4	32.6	33.6	
5th or 6th	53.3	42.4	42.5	44.2	
Total	100	100	100	100	
An app that a healthcare provider recommended					$\chi^2(4)$ =14.4642; P=0.006
1st or 2nd	75.2	70.8	*62.4*[†]	70.0	
3rd or 4th	20.6	22.3	23.8	22.3	
5th or 6th	4.2	6.9	*13.8*	7.7	
Total	100	100	100	100	
An app that was recommended in a news article or blog post					$\chi^2(4)$ =14.9705; P=0.005
1st or 2nd	6.1	8.7	*16.6*	9.7	
3rd or 4th	36.4	33.5	35.9	34.4	
5th or 6th	57.6	57.8	*47.5*	55.9	
Total	100	100	100	100	
An app that had published research conducted on it					$\chi^2(4)$ =7.6845; P=0.104
1st or 2nd	60	54.9	46.4	54.2	
3rd or 4th	26.1	31.5	38.7	31.9	
5th or 6th	13.9	13.6	14.9	13.9	
Total	100	100	100	100	
An app that was recommended by a government or nonprofit group					$\chi^2(4)$ =2.4450; P=0.655
1st or 2nd	17.6	15.4	14.9	15.7	
3rd or 4th	37	35.2	31.5	34.8	
5th or 6th	45.5	49.4	53.6	49.5	
Total	100	100	100	100	

[†], italic values indicate statistically significant difference between observed and expected frequencies based on adjusted residuals.

Table 6 Search term categories, frequency, proportion, and exemplar terms (N=1,388)

Search term category	Frequency	Proportion of all search terms	Common keywords	Example
Prevent pregnancy (general)	405	32.90	Pregnancy, prevention, avoid	"not get pregnant" "pregnant prevention app"
Having a period	301	24.45	Period, cycle, menstrual	"know your flow" "monthly cycle monitor"
Fertility (general)	174	14.13	Fertility, fertile days, calendar	"what are my most fertile days"
Track ovulation	96	7.80	Ovulation, ovulation tracking, egg	"egg cycle app" "ovulation calculator"
Birth control	88	7.15	Birth control, reminder	"birth control scheduling app" "birth control reminder"
Where to look for apps	41	3.33	Google, app store, internet	"Google play store" "Facebook or app store"
User unsure how to search for fertility app	31	2.52	Not sure, don't know	"no idea" "not sure what to look for"
FABM[‡] specific terms	25	2.03	Rhythm method, calendar method	"rhythm method app" "billings" "creighton"
Family planning/planning a pregnancy	24	1.95	Family planning, planned pregnancy	"planning ahead" "planning for baby"
Contraception (non-fertility awareness-based methods)	22	1.79	Pill, contraceptive	"hormone app" "contraception in the pharmacy"
Women's health (general)	11	0.89	Women's apps, women's health	"women's health" "women's health apps"
Advice on sexual intercourse or safe sex	8	0.65	Safe sex, careful sex	"sex education" "most safe time to have sex before my period"
Qualities desired in apps	5	0.41	Reliability, quality	"high quality" "mobile accurate app"

[‡], fertility-awareness based methods.

in order to maximize available sample size and assess knowledge differences. However, we also conducted a sensitivity analysis to assess if there were differences between current users and women who are interested in using fertility apps, as it is probable that there are differences between people who are actively using an app versus those who are interested in doing so in the future. To test this, we ran the same statistical analysis restricted to current users only (n=231). Trends across knowledge groups when restricted to users were consistent with the results from the overall sample, although statistical power was too low to detect most statistical differences between knowledge groups.

Discussion

Our findings demonstrate an interest in and increasing demand for fertility apps that can be used to prevent pregnancy. In our recruitment process and in our final sample, the number of women who have used these apps to prevent pregnancy is small, compared to the number who indicate that they intend to do so in the near future, suggesting that future interventions aimed at educating women around appropriate fertility apps are needed, in order to help growing numbers of women prevent unintended pregnancy.

In short, users wishing to prevent pregnancy with a digital tracking tool want the app to be science- and

research-backed, have sophisticated features like predicting ovulation and menses, while maintaining assurances of privacy. Not surprisingly, women's clear preferences for evidence, assurances and medical accuracy are consistent with documented antecedents of online trust in apps (20). Fertility app users seem to correlate scientific evidence used in the development and marketing of an app with the likelihood of intended results, similar to how other forms of birth control are viewed. Yet, despite this noted preference, few of the fertility apps that users reported actually using were intended to help a woman prevent pregnancy. It is possible that app developers who use scientific jargon to promote their apps are perceived as being "scientifically-based" in a similar manner to the way that the use of "scientific" terminology has been used to improve consumer confidence in beauty products (21). Further research is needed in this area to understand how women determine if an app is based on scientific evidence, and how credibility assurances are communicated to women selecting apps.

Surprisingly, users who reported some form of provider counseling were not more knowledgeable about basic fertility than other women in the sample, disproving our hypothesis. Some women believe they have been counseled by a provider on FABM when in fact there may not be a common base of understanding among app users about what constitutes a FABM or what is simply fertility awareness, or period or ovulation monitoring. Provider willingness to discuss FABMs is generally very low, and most FABM take months to appropriately train (for example, symptothermal method requires a trained person teaching a woman how to chart menses and helping her interpret charts over the course of several months). When searching for a fertility app to help prevent pregnancy, a sizable user portion (about one fifth) looked for apps using terms unrelated to pregnancy prevention, having a period, or ovulation—some terms even pointed to a desire to use an app to remind them to take birth control pills. These findings underscore a general unreliable base of knowledge among women about what FABM are and what they are not. It is important for comprehensive sexuality education programs to include FABM and showcase the breadth of science behind these methods for fertility planning.

One of the most striking observations we note is that most fertility apps women reported that they have used were not designed as a digital FABM platform to facilitate the recording of fertility signs and deliver interpretative capability. This poses a highly problematic disconnect between the capacities of apps for pregnancy prevention and the clearly stated preferences among women for features and design based on scientific evidence. It is likely that there is a preference for monitoring apps about health to be based in science globally, but this is an understudied area. Given the consumer demand we observe in this study for fertility apps used specifically for pregnancy prevention, much more research is needed in this unique consumer space to understand how women can be informed consumers.

Our study has several limitations. Our strategy to sample fertility app current and interested users exclusively from a social networking platform and the self-reported nature of the online survey limit how generalizable our findings will be for a broader population. There is diversity among fertility app users, particularly outside of the U.S. context, that is not represented in our study. Our survey and knowledge questions are not validated items. We also acknowledge our small sample size for actual fertility app users compared to intended users, which may contain more meaningful differences that we were able to explore in this study.

Conclusions

Despite limitations, this is the first study of its kind to look at women who specifically wish to use fertility apps to prevent pregnancy. Perhaps most importantly, our study speaks to a growing trend among women to use apps to prevent pregnancy. It is critical that app developers, researchers, and women's health advocates collaborate to develop apps with the preferred functionality women desire. Equally critical is for developers to clearly delineate limitations of apps, and the extent to which an app should be marketed as having the capacity to help prevent pregnancy. While it is beyond the scope of this study to examine the accuracy or efficacy of fertility apps for pregnancy prevention, our study points to women's confidence and trust in apps for this purpose already. Research is needed to not only investigate accuracy and efficacy for fertility apps for pregnancy prevention, but also so we may build accountability structures and transparency for the app marketplace. The development of a validated fertility knowledge instrument would also be useful in advancing this research. Informed consumer campaigns have a role to play in marketing apps to women that do have the capacity to act as digital platforms for proven FABM and have research to support their efficacy (22-24). For women who want to use these tools to prevent pregnancy, consumer education and behavior change communications to bolster informed health decision-making, including

educating about app credentials and selection criteria, will also improve informed utilization.

Acknowledgements

The authors would like to thank Drs. Victoria Jennings and Dominick Shattuck at the Institute for Reproductive Health at Georgetown University for their substantive contributions in the scope, design, and execution of this pilot study.
Funding: This study was supported by the United States Agency for International Development grant (No. AID-OAAOAO13O00083) under the FACT Project.

Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

Ethical Statement: The objective of this pilot study was to understand fertility app preference from aggregate data. Identifiable information was not collected, the sample size is not reflective of the general population and thus limits generalization, and due to these factors IRB approval was not sought out. All participants in this study confirmed they were over the age of 18 and gave informed consent to participate in the study.

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doi: 10.21037/mhealth.2018.06.02
Cite this article as: Starling MS, Kandel Z, Haile L, Simmons RG. User profile and preferences in fertility apps for preventing pregnancy: an exploratory pilot study. mHealth 2018;4:21.