

The Accuracy of Web Sites and Cellular Phone Applications in Predicting the Fertile Window

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OBJECTIVE: To evaluate the validity of fertility web sites and applications (apps) by comparing the predicted fertile window of these modalities to the actual fertile window of a standard 28-day cycle.

METHODS: This was a descriptive study. The top resulting free web sites and electronic apps downloadable to a cellular phone that provide calendars for fertility and ovulation prediction were assessed. Cycles were standardized to 28 days in length, 4 days of menses, and the last menstrual period was set to January 1, 2015. The predicted date of ovulation and fertility window generated were compared with an actual estimated date of ovulation on cycle day 15, January 15, and a fertile window consisting of cycle day 10 to cycle day 15, the day of ovulation plus the preceding 5 cycle days, January 10–15.

RESULTS: Data from 20 web sites and 33 apps were collected. Of all the web sites and apps used, one web site and three apps predicted the precise fertile window.

CONCLUSION: Web sites and electronic apps used by the general public to predict fertile windows are generally inaccurate, although the clinical effect of this inaccuracy is unknown. Although they all include the most

fertile cycle day, the range of the fertility window varies widely. Patients who are trying to conceive with the assistance of calendars generated from web sites and electronic apps should be counseled on the inaccuracy of these modalities.

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Timed intercourse during the menstrual cycle is one of the main strategies used by couples trying to conceive. Current data suggest that 10.9% of women aged 15–44 years have impaired fecundity, and there are 1.5 million married women ages 15–44 years who are unable to conceive after 12 consecutive months of unprotected sex.¹ Before initiating workup for infertility, physicians are tasked with ensuring that couples are timing intercourse in an appropriate way to maximize the couples' chance for childbearing.

Historically, different modalities have been used to time intercourse in relation to ovulation including basal body temperature measurement, assessment of cervical mucus, and ovulation prediction kits. These methods have been shown to have varying degrees of accuracy and success.² Recently, a number of web sites and cellular phone applications (apps) have emerged that offer predictions of ovulation dates and a “fertile window” during which couples are most likely to conceive. These programs generate this information by prompting the user to enter the date of the last menstrual period and the usual cycle length.

Although a definitive fertile window of a regular menstrual cycle is difficult to determine, the “gold standard” established by Wilcox et al³ assumes that the most fertile days in a cycle are the date of ovulation and the 5 preceding cycle days. Against this background, we sought to assess the accuracy of web sites and apps by comparing the predicted fertile window of the top resulting free web sites and apps against the actual presumed fertile window.

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Table 1. Fertility Windows and Ovulation Dates Predicted by Web Sites Compared With the Average U.S. Fertility Period (Gold Standard)*

Web Site No.	Predicted Fertile Window (January)	Predicted Date of Ovulation	No. of Days Outside the Fertile Window [†]	No. of Fertile Days Not Included [†]	% Accuracy [‡]
1	11–21	NA	6	1	45
2	12–16	January 15	1	2	80
3	12–17	NA	2	2	66.6
4	12–17	NA	2	2	66.6
5	11–14	January 14	0	2	100
6	10–15	January 15	0	0	100
7	11–15	January 15	0	1	100
8	11–16	NA	1	1	83
9	13–17	January 15	2	3	60
10	12–16	January 15	1	2	80
11	13–17	NA	2	3	60
12	13–19	NA	4	3	43
13	14–18	NA	3	4	40
14	11–15	January 14	0	1	100
15	12–16	January 15	1	2	80
16	12–17	NA	2	2	66.6
17	12–15	NA	0	2	100
18	12–17	January 15	2	2	66.6
19	13–17	NA	2	3	60
20	12–16	January 15	1	2	80

NA, not applicable.

* Gold standard fertility window, January 10–15.

[†] January 10–15.

[‡] Calculated by dividing the total number of correct predicted fertile days by the total number of predicted fertile days, both correct and incorrect.

MATERIALS AND METHODS

This descriptive study was conducted without the need for approval by the institutional review board because no human subjects were used.

A Google web browser search was performed using the search terms “ovulation calendar” and “fertility calendar.” The top 20 resulting web sites that provided a free online fertility calendar were accessed. For the purposes of this study, we chose a last menstrual period of January 1, 2015. If prompted to provide the information, a 28-day cycle length was used and a 4-day length of menses was entered into the fertility calendar tools. The fertile window and predicted date of ovulation generated by the site were recorded.

This process was repeated using the search term “fertility calendar” on a Samsung Galaxy cell phone using the Google Play app downloading system for Google’s Android⁴ and Apple’s iOS⁵ using Apple’s App Store. The top 20 free apps that resulted were downloaded. Again, a last menstrual period of January 1, 2015, and a 28-day cycle length with 4 days of menses were used.

All web sites and apps were accessed on February 19, 2015. The top 20 web sites and apps were chosen

to attempt to replicate what the general public would be likely to use. The predicted dates of ovulation were compared with an assumed actual date of ovulation of cycle day 15, January 15, 2015. If a date of ovulation was predicted, it was deemed accurate if this date resulted or inaccurate if any other date resulted. The fertile windows were compared with an assumed actual fertile window consisting of the date of ovulation and the preceding 5 cycle days, 10–15 (January 10–15). The generated fertile windows were considered accurate if they exactly matched the actual predicted fertile window. Percentages of correct fertile windows were calculated along with 95% confidence intervals for the true percentages among all available web sites and apps. The number of actual fertile days included in the generated fertile windows was recorded. In addition, the number of cycle days outside the fertile window that were included in the generated fertile window was recorded. Web sites and apps were excluded if a fee was required. Additional percentages and 95% confidence intervals of interest were calculated. Percent accuracies for each individual web site and app, and for the web sites in aggregate and apps in aggregate, were calculated by dividing the total number of correct predicted fertile days by the total



Table 2. Fertility Windows and Ovulation Dates Predicted by Android Applications Compared With the Average U.S. Fertility Period (Gold Standard)*

Application No.	Predicted Fertile Window (January)	Predicted Date of Ovulation	No. of Days Outside the Fertile Window [†]	No. of Fertile Days Not Included [†]	% Accuracy [‡]
1	13–17	NA	2	3	60
2	10–17	NA	2	0	75
3 [§]	11–14	January 14	0	2	100
4	13–17	January 15	2	3	60
5 [§]	10–16	NA	1	0	86
6 [§]	12–17	January 15	2	2	66.6
7	7–19	January 15	7	0	46
8	10–17	January 15	2	0	75
9	11–17	January 15	2	1	71
10 [§]	10–15	January 15	0	0	100
11 [§]	12–17	NA	2	2	66.6
12 [§]	12–15	January 15	0	2	100
13	11–16	NA	1	1	83
14	8–18	NA	5	0	55
15	10–16	January 15	1	0	8
16	10–16	January 15	1	0	86
17	10–16	January 15	1	0	86
18	10–17	NA	2	0	75
19	11–18	January 15	3	1	63
20 [§]	11–18	January 15	3	1	63

NA, not applicable.

* Gold standard fertility window, January 10–15.

[†] January 10–15.

[‡] Calculated by dividing the total number of correct predicted fertile days by the total number of predicted fertile days, both correct and incorrect.

[§] Duplicate applications in Apple iOS and Android.

number of predicted fertile days. Microsoft Word and Google spreadsheets were used to analyze the data and form the graphs.

RESULTS

There were 20 web sites that provided the desired information in an easily accessible format within the first two result pages using the search terms described. The top 20 free apps on Android and on iOS were downloaded. Tables 1–3 show details for each web site and app analyzed, respectively. There were seven apps that appeared on both the Android and iPhone lists to make a total of 33 distinct apps.

Some of the calendars did not specify a single cycle day as the date of ovulation. Ten of the 20 web sites (50%, confidence interval [CI] 0.27–0.73) and 23 of the 33 apps (69.7%, CI 0.53–0.84) provided a predicted date of ovulation. The calendars that specified a cycle day for ovulation were generally accurate with 8 of 10 web sites (80.0%, CI 0.44–0.98) and 20 of 23 apps (86.9%, CI 0.66–0.97) predicting a correct ovulation date of January 15.

Of all the web sites and apps used, one web site (web site 6) and three distinct apps (apps 10, 21, and

24; 32 is the iOS version of 10) predicted the precise fertile window of January 10–15. Five of the web sites (25.0%, CI 0.09–0.49) and five of the apps (15.2%, CI 0.05–0.32) generated a window that consisted only of days within the actual fertile window but did not include all fertile cycle days. Fifteen of 20 web sites (75.0%, CI 0.51–0.91) and 26 of 33 apps (78.8%, CI 0.61–0.91) had fertility windows that contained days after ovulation.

The range of dates generated by apps and web sites defining the fertility window were as early as cycle day 5 and as late as cycle day 21. The web sites and apps also varied in the amount of total days included in their fertile windows. In aggregate 74% of all the predicted fertile days by web sites were within the actual fertile window (Fig. 1), and 75% of all the predicted fertile cycle days by apps were within the fertile window (Fig. 2). The longest estimated length of a fertile window was 12 days, predicted by one app. The shortest fertile window duration was 4 days, which was predicted by two apps and two web sites. Cycle day 14 was the only cycle day that was always included as part of the fertile window in all web sites and apps analyzed. Finally, percent accuracies were calculated



Table 3. Fertility Windows and Ovulation Dates Predicted by Apple iOS Applications Compared With the Average U.S. Fertility Period (Gold Standard)*

Application No.	Predicted Fertile Window (January)	Predicted Date of Ovulation	No. of Days Outside the Fertile Window [†]	No. of Fertile Days Not Included [†]	% Accuracy [‡]
21	10–15	January 14	0	0	100
22	8–19	January 15	6	0	50
23 [§]	11–14	January 14	0	2	100
24	10–15	January 15	0	0	100
25	12–16	January 15	1	2	80
26 [§]	12–15	January 15	0	2	100
27	10–16	January 15	1	0	83
28	10–18	January 15	3	0	66.6
29 [§]	12–17	January 15	2	2	66.6
30	10–16	January 15	1	0	86
31	9–14	NA	1	1	83
32 [§]	10–15	January 15	0	0	100
33 [§]	11–17	NA	2	1	71
34	11–16	NA	1	1	83
35	5–15	January 12	5	0	55
36	10–16	January 15	1	0	86
37	11–17	NA	2	1	71
38 [§]	10–16	NA	1	0	86
39	10–16	January 15	1	0	86
40 [§]	11–18	January 15	3	1	63

NA, not applicable.

* Gold standard fertility window, January 10–15.

[†] January 10–15.

[‡] Calculated by dividing the total number of correct predicted fertile days by the total number of predicted fertile days, both correct and incorrect.

[§] Duplicate applications in Apple iOS and Android.

for each web site and app and are listed in their respective tables.

DISCUSSION

This study demonstrates that web sites and cellular phone apps used to predict fertile windows and dates of ovulation are generally inaccurate and unreliable,

because only four of all the resources analyzed were exactly accurate.

In 1967, Barrett and Marshall⁶ were among the first to attempt calculating probabilities of conception on different days of the menstrual cycle. Using basal body temperatures to predict the date of ovulation, they concluded that fecundability increased 5 days

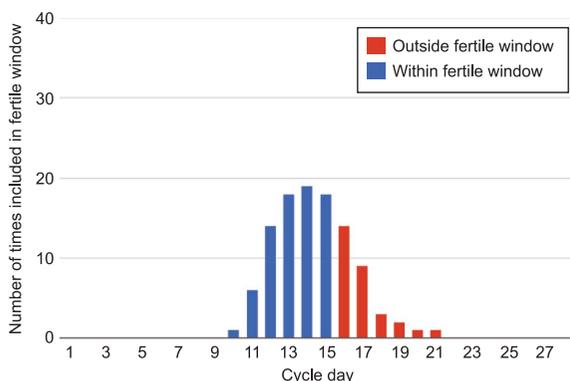


Fig. 1. Number of times each cycle day is included as part of the fertile window on web sites.

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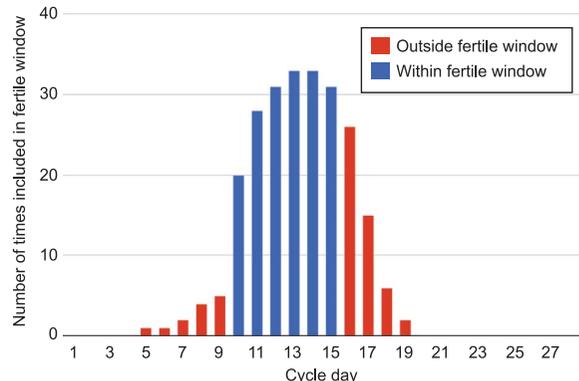


Fig. 2. Number of times each cycle day is included as part of the fertile window in applications.

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before ovulation and dropped sharply after ovulation. Since that time, several studies have attempted to further characterize the “fertile window” of the menstrual cycle.^{3,6–13} In 1995, Wilcox et al analyzed healthy women attempting pregnancy. The ovulation date was predicted using measurements of estrogen and progesterone metabolites in urine. They concluded that the fertile window consisted of the 6-day period ending on the day of ovulation. No pregnancies were attributed to the days after ovulation.³ Subsequent published studies have supported this and added that the day of highest fecundability is the day before ovulation and that the probability of pregnancy on the day after ovulation is nearly zero.^{2,7}

Couples trying to conceive use a variety of tools to help time intercourse to achieve pregnancy including basal body temperature, cervical mucus monitoring, and ovulation prediction kits. Each of these methods has certain advantages and drawbacks, and some have been shown to improve pregnancy rates.^{2,14,15} Patient use of medical web sites and apps has gained popularity in the last decade in obstetrics and gynecology^{16–18} and in health care in general.¹⁹ These apps and web sites have substantial reach—some of them boast more than 10 million downloads, as was noted while conducting this study.

Our findings show that the use of web sites and apps for prediction of fertile windows in patients with regular cycles should be applied with caution. Although all of these resources are inclusive of at least some of the fertile window, and approximately 74–75% of predicted fertile days are actually within the fertile window, most also counsel intercourse on days that are not conducive to conception. A large percentage of the resources analyzed included days after ovulation within their fertile window, which is known to be incorrect. The range of predicted fertile windows included days as early as 5 cycle days before the start of the fertile window and up to 6 days after ovulation. Including days too early in a cycle may alter fecundability because couples often abstain for several days before the onset of the fertile window to increase sperm concentration for first intercourse. Furthermore, intercourse in the periimplantation period, defined as the time the blastocyst is free in the uterus to the time of implantation, may also lower fecundability.²⁰ This all may lead to patients having intercourse in patterns that will not maximize their chances of conceiving.

The value of our analysis is its simplicity. There is a wide variation in the menstrual cycle. Even in women with 28-day cycles, the fertile window varies from cycle to cycle.²¹ The purpose of the apps and

web sites is to predict the fertile window in each individual woman. Even in our typical patient with a 28-day cycle and luteinizing hormone surge on day 14, we were able to demonstrate that almost all of the apps and web sites were inconsistent in predicting a precise fertile window. Although for this study we assumed a “perfect cycle,” it can be implied that with the inherent variation in actual cycles, the predicted fertile windows may be even more inaccurate.

Limitations of this study include the fact that only the top 20 free web sites and apps were incorporated into the study. The search terms used were at the discretion of the authors, and different web sites or apps may have been included if different search terms were used. Although the reason for this was to include the most relevant and accessible data available to the public, the authors acknowledge that there may be selection bias.

Further studies are warranted to assess the clinical effect of the use of web sites and apps in couples trying to conceive by reviewing pregnancy rates in patients who use these resources. In these studies, attention can also be paid to whether the resources can predict fertility based on menses length and in patients with different cycle lengths.

Because there is no rigorous screening process in effect to vet these web sites and apps, we recommend caution in their use to assist with fertility. Practitioners should be aware that most of these give patients inaccurate information, and patients should be counseled accordingly.

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