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Mobile Health Approaches to Breastfeeding

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Abstract: Breastfeeding is available to nearly all women and has well-established short-term and long-term health benefits for mothers and infants. However, rates of breastfeeding initiation and continuation vary significantly according to sociodemographic factors, particularly in the United States. Mobile health (mHealth) interventions such as web-based/online education or smartphone applications have showed promise in increasing breastfeeding initiation and supporting breastfeeding continuation, and the importance of such mHealth-based breastfeeding support has increased significantly during the ongoing COVID-19 pandemic. This expert commentary reviews prior studies on mHealth in breastfeeding and highlights areas for future research on this topic.
Key words: breastfeeding, smartphone application, mobile health (mHealth), new media, postnatal breastfeeding support or education

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Introduction

Breastfeeding is available to nearly all women and, when sustained for at least 6 months, is associated with significant health benefits for both mothers and babies. For mothers, sustained breastfeeding is associated with increased rates of postpartum weight loss in the short term[1] and lower rates of type 2 diabetes, breast or ovarian cancer, hypertension, postpartum depression, and cardiovascular disease in the long term.[2,3] For infants, those who are breastfed have better immunity, neurodevelopment, nutrition, and overall health in the first 6 months of life than those who are exclusively formula-fed.[2,3] In addition, breastfeeding appears to affect rates of childhood obesity: between the ages of 9 and 14, children who had been only or mostly breastfed as infants were significantly less likely to be overweight than those who were exclusively formula-fed.[3] In fact, the Centers for Disease Control's obesity prevention campaign specifically highlights the need to

increase breastfeeding rates to decrease childhood obesity.[4]

Given breastfeeding's clear benefits, the American College of Obstetricians and Gynecologists recommends exclusive breastfeeding for 6 months.[3] However, in the United States, only 75% of women initiate breastfeeding, and the rates are significantly lower among African-American women (59%) and low-income women (66% of those in the Special Supplemental Nutrition Program for Women, Infants, and Children).[3] This health disparity is also seen in sustained breastfeeding; among American women who initiate breastfeeding, 51.8% breastfeed with or without formula supplementation at 6 months, whereas only 41.5% of low-income women and 40.0% of African-American women living in cities do so.[5] Women who are both low income and urban have even lower breastfeeding rates than those who are solely low income or urban.[6] Thus, interventions are urgently needed to increase breastfeeding rates, particularly among low-income, urban, or African-American women.

Mobile health (mHealth)-based interventions such as web-page (online) education or smartphone applications may provide an ideal means to increase rates of breastfeeding overall and specifically among low-income, urban, or African-American women. This idea is based on 2 key lines of evidence. First, meta-analyses have suggested that mHealth interventions improve long-term management of chronic diseases such as diabetes, hypertension, and chronic lung disease.[7] Within women's health, mHealth interventions have increased intrauterine device uptake rates,[8] decreased rates of postpartum smoking,[9] and increased patient comprehension of aneuploidy testing options[10] and informed consent for hysterectomy.[11] Second, meta-analyses have shown that individual-level education and support interventions, such as brief in-person teaching sessions, that are available during pregnancy and after delivery result in the highest increases in breastfeeding rates.[2] Given that mHealth interventions can be individual-level education and support interventions[7] and can be made available during pregnancy and postpartum, it is reasonable to posit that well-designed mHealth interventions could increase breastfeeding rates overall and, in particular, among women who are less likely to initiate or sustain breastfeeding.

The ongoing coronavirus pandemic heightens the importance of mHealth in providing breastfeeding support. During this pandemic, the primary concern of governments, public health organizations, and health care systems has been to take care of the acutely ill and to enact measures and policies to decrease the rate of community spread. However, though these policies have no doubt decreased the spread of COVID-19, they may have significant downstream health consequences, including on breastfeeding rates. Indeed, as hospitals limit visitors in postpartum units, lactation consultant-led in-person breastfeeding support groups are canceled, postpartum visits are being held virtually instead of in-person, and many states require 2-week quarantine for out-of-state visitors, postpartum women struggling with breastfeeding have lost access to traditional methods of support. The widespread implementation of effective mHealth-based breastfeeding interventions may help offset this lack of access during the ongoing pandemic.

In this expert commentary, we summarize the literature describing the effect of mHealth interventions on breastfeeding, focusing on the 2 most published types of mHealth interventions: breastfeeding support or education that is either web-based (online) or smartphone application (app)-based. In addition, we identify areas where future high-quality research is needed to further examine the role of mHealth in breastfeeding support.

PUBLISHED LITERATURE ON MHEALTH AND BREASTFEEDING

Web-based mHealth breastfeeding interventions

Interactive web-based mHealth interventions combining breastfeeding education and support have been utilized in multiple published studies (Table 1).[12–20] Though technically fitting under the umbrella of mHealth, each study intervention was strikingly different from the others, adding heterogeneity to any attempt to conduct a meta-analysis or systematic review on the impact of web-based education on breastfeeding rates. For example, Giglia et al[15] used web-based interactive and asynchronous online discussion boards, while Alberdi et al[13] and Hannula et al[17] provided women with an educational website with either online and in-person breastfeeding support or an educational breastfeeding game, respectively. Similarly, Geoghegan-Morphet et al[14] designed a web-based breastfeeding support clinic combining on-demand breastfeeding education with peer and professional support, Giglia provided access to a certified lactation consultant through web-based posts or a webcam,[15] while Grassley et al[16] used a game-based learning platform on the web in which study participants completed "quests" through web-based education activities.

Despite the difference in actual intervention between studies, most web-based mHealth breastfeeding support or education improved breastfeeding rates,[12–15,17–20] though outcomes were measured differently between studies. Indeed, some analyzed the intervention's effect on breastfeeding during the immediate inpatient postpartum period,[17,20] whereas most extended the study period until up to 6 months postpartum.[12–16,18,19] It is also important to highlight that the effect of web-based breastfeeding support varied pending on country of study completion and participant demographics. For example, most studies—and virtually all that demonstrated a positive effect of web-based breastfeeding support—were conducted in Europe or Asia,[13–15,17–20] whereas only one[12] of the 2 studies completed in the United States[12,16] did so. In the American Midwest, Ahmed et al[12] demonstrated—in the only published randomized trial to date—that a web-based breastfeeding monitoring program similar to an online diary significantly improved self-reported rates of breastfeeding at 3 months postpartum (from 66% in control group to 84% in the intervention group). Conversely, Grassley et al[16] showed no difference in breastfeeding rates, despite women reporting an increased likelihood to prefer exclusive breastfeeding after completing the web-based game compared with those who did not. Differences in the impact and perception of web-based mHealth breastfeeding interventions were also identified internationally: Alberdi et al[13] found that Irish mothers who lived in rural areas were much more likely than their urban counterparts to prefer web-based breastfeeding support to in-person breastfeeding support.

Thus, more research is urgently needed in the United States to examine whether web-based breastfeeding support can improve breastfeeding rates in diverse populations. This research must be conducted in such a way that patient preferences are assessed first and then incorporated into the web-based intervention in order to accommodate for patient demographic factors that may make virtual breastfeeding support more or less accessible or desirable. Indeed, incorporating patient feedback and preferences into web-based researchers will ensure the intervention is optimized to the targeted patient population. In addition, future research in Europe and Asia must focus on examining whether web-based or online-based breastfeeding support interventions are as effective among geographically or economically marginalized women as has been shown

TABLE 1. Characteristics of Published Studies Using Web-based Breastfeeding Education or Support Interventions

Study Information	Study Setting	Study Design	Number of Participants	Study Duration	Study Intervention	Breastfeeding Outcomes	Assessment
Ahmed et al[12]	United States	Randomized trial	141	Delivery until 3 mo postpartum	Web-based monitoring program	(1) Breastfeeding support (2) Breastfeeding education	(1) Breastfeeding diary (2) Survey
Alberdi et al[13]	Ireland	Pilot (feasibility) study	100	Pregnancy until 3 mo postpartum	Online discussion forum	Breastfeeding duration	Web-based survey
Geoghenan-Morphet et al[14]	Canada	Qualitative	200	Delivery until 6 mo postpartum	(1) Online discussion forums (2) Personal web-based lactation consultant	(1) Breastfeeding support (2) Breastfeeding education (3) Breastfeeding outcomes (initiation and duration)	Survey
Giglia et al[15]	Australia	Prospective cohort	414	Pregnancy until 12 mo postpartum	(1) Online discussion forums (2) Personal web-based lactation consultant	(1) Breastfeeding outcomes (initiation and duration; exclusive) (2) Breastfeeding support	Survey
Grassley et al[16]	United States	Preimplementation/ postimplementation	41	Pregnancy until 1 mo postpartum	Educational game	(1) Breastfeeding intention (2) Breastfeeding self-efficacy (3) Breastfeedinge ducation	Survey
Hannula et al[17]	Finland	Quasi-experimental	705	Pregnancy until 1 wk postpartum	Web-based education and game	(1) Exclusive breastfeeding (2) Breastfeeding confidence/ attitude (3) Breastfeeding coping	Survey
Huang et al[18]	Taiwan	Quasi-experimental	120	Pregnancy until 6 wk postpartum	Online discussion forums	(1) Breastfeeding knowledge (2) Breastfeeding duration (3) Breastfeeding attitude	Survey
Newby et al[19]	Australia	Prospective cohort	488	Pregnancy until 12 mo postpartum	Online discussion forums	(1) Breastfeeding support (2) Breastfeeding education	Web-based questionnaires
Solonen et al[20]	Finland	Quasi-experimental	863	Pregnancy until hospital discharge	Online discussion forums	Exclusive breastfeeding	In-person survey

previously. Regardless of where the research is conducted, future studies should contain a control group of routine care and be examined prospectively to provide high-quality data.

Smartphone application-based mHealth breastfeeding interventions

Compared with web-based breastfeeding interventions, fewer studies have been published using smartphone application (apps) to provide breastfeeding support (Table 2).[21–24] Though less commonly examined, smartphone apps have notable advantages when compared with web-based interventions. First, in the United States, low-income women are less likely to have internet than a smartphone[25]: 96% of Americans aged 18 to 29 and 71% of those earning <$30,000 annually own a smartphone[26] (vs. 77% and 56%, respectively, with internet access[25]). Second, app-based content provides 2 specific advantages compared with online content: (1) when embedded within a smartphone app, all content can be accessed independent of cellular or internet service, (2) apps can function as just-in-time adaptive interventions by incorporating what is called ecologic momentary assessments. Ecologic momentary assessments offers targeted therapy by prompting app users to answer a screening question then providing content tailored to their individual responses, effectively delivering real-time, accurate assessments in real-life situations,[27,28] optimizing and individualized health care delivery. Given these advantages, it is likely that more studies will soon be published examining the effect of app-based breastfeeding support on infant nutrition outcomes.

Similar to the web-based mHealth interventions, the smartphone applications used as breastfeeding interventions were significantly distinct from each other. Some studies used commercially available apps: for example, the app used in the study by Wheaton et al[24] was produced by a certified lactation consultant while that used in the study by Farr et al[21] was designed by a community-building organization to identify supportive breastfeeding champions for users. Other researchers developed their own apps to target specific barriers their research identified that prevented specific populations of women from continuing to breastfeed. For example, Wang et al[23] created an app to help Thai women overcome breastfeeding difficulties after hospital discharge, while the app created by Lewkowitz et al[22,29] contained on-demand videos on breastfeeding, infant care, and postpartum health that targeted specific challenges low-income women in St. Louis identified as preventing them from breastfeeding exclusively at hospital discharge.[30]

Both studies employing commercially available apps demonstrated a significant increase among women exposed to app-based breastfeeding education compared with those unexposed,[21,24] whereas the only study employing a novel app did not produce any change in breastfeeding rates, when examined in primary[22] or secondary analyses.[29] The study by Wang et al[23] focused on usability and did not include breastfeeding outcomes. This may be because of study differences. First, women exposed to a the commercially available apps were not compared with a control group,[21,24] obscuring the potential effect of a technology-based study intervention on breastfeeding outcomes. Second, the study populations were different between studies. For example, the study by Wheaton et al[24] was conducted in rural Australia, which has a much higher baseline of exclusive breastfeeding at 6 months postpartum than in the United States, whereas the low-income American women who participated in the study by Farr et al[21] were required to complete formal breastfeeding education before study enrollment but those in

TABLE 2. Characteristics of Published Studies Using Smartphone Application-based Breastfeeding Education or Support Interventions

Study Information	Study Setting	Study Design	Number of Participants	Study Duration	App Name	Commercial Availability	Breastfeeding Outcomes	Assessment
Farr et al[21]	United States	Longitudinal survey	243	Pregnancy until 2 d postpartum	Coeffective	Yes	(1) Intention to exclusively breastfeed (2) Patient satisfaction (3) Exclusive breastfeeding	Survey
Lewkowitz et al[22]	United States	Randomized trial	170	Pregnancy until 6 mo postpartum	BreastFeeding Friend	No	(1) Breastfeeding initiation and duration (2) Breastfeeding challenges (3) Ideal breastfeeding support mechanism	Survey
Wang et al[23]	Thailand	Mixed methods	21	Delivery until 4 wk postpartum	MoomMae	No	(1) Breastfeeding support (2) Breastfeeding education	(1) Survey (2) Structure interview
Wheaton et al[24]	Australia	Prospective cohort	46	Delivery until 6 mo postpartum	Breastfeeding Solutions	Yes	(1) Breastfeeding duration (2) Breastfeeding confidence	Web-based survey

the study by Lewkowitz et al were not.[22,29] Lastly, because the studies by Wheaton and colleagues and Farr and colleagues used commercially available technology interventions,[21,24] they could not determine whether the app was actually utilized by study participants. Indeed, the app used by Lewkowitz et al[22,29] contained an embedded tracker providing data on app usage, which demonstrated that participants had an overall low rate of app use during the study period.

Thus, to date, in the one published randomized controlled trial, a smartphone application did not improve breastfeeding rates, though 2 prospective uncontrolled studies demonstrate that app-based breastfeeding education and support does improve breastfeeding rates. Further research through high-quality randomized trials is urgently needed to better examine the impact of app-based breastfeeding support on infant nutrition outcomes. Ideally, these studies will include apps with embedded trackers to confirm app usage during the study period.

Conclusions

Overall, both web-based and app-based breastfeeding support have been proven to be not only feasible but effective in improving breastfeeding rates in the short-term and long-term in a global population of study participants. However, more research is needed to confirm the efficacy of mHealth breastfeeding interventions in economically, geographically, and racially/ethnically diverse group of women. This research must take into consideration that different mHealth breastfeeding interventions may be needed in different patient populations incorporate a precision-medicine-type approach and likely more effectively improve infant nutrition outcomes in distinct communities. This need is particularly urgent as traditional in-person

postpartum and lactation support becomes replaced with virtual care in the setting of the ongoing global pandemic and beyond.

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