



Mobile Phone Applications to Support Breastfeeding Among African-American Women: a Scoping Review

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Abstract

Background Racial disparities persist with respect to breastfeeding. The use of health e-technology is increasing, with promise for a role in improving breastfeeding outcomes.

Objective We undertook a scoping review of both individual breastfeeding apps and the literature on breastfeeding apps to map the available evidence on app-based breastfeeding support for African-American mothers.

Design A systematic search of online databases identified 241 English language papers published on or before June 2020 that included e-technology in support of breastfeeding. We included those that (1) described individual human subjects research studies utilizing any research design, (2) described app-based breastfeeding support, and (3) could be pertinent for African-American mothers, and assessed for inclusion and relevance for this population. We also searched app stores for breastfeeding apps, and evaluated features with a rubric. Our aim was to identify if gaps exist relative to breastfeeding support for African-Americans.

Results Of the 15 publications meeting inclusion criteria, 9 focused on app development, 4 examined user experience, and 3 examined breastfeeding outcomes with use of an app (one study overlapped categories). The percentage of African-American participants ranged from 100% (2 studies) to none (7 studies); 3 studies (20%) focused on African-American mothers' breastfeeding experience. Of 77 apps that met inclusion criteria, just one was both breastfeeding-focused by content and targeted for African-Americans by picture predominance.

Conclusions The quality of studies was generally high and many included African-American participants, but research focused on breastfeeding apps specifically for African-American mothers/parents is limited, creating a meaningful gap in the literature.

Keywords African Americans · Breast feeding · Mobile apps · Smart phone · Mobile phone · Health Care Disparities

Background

Breastfeeding is recommended as the optimal infant feeding method by multiple national and international professional organizations [1–3]. Population-wide exclusive breastfeeding through six months, with continued breastfeeding after introduction of complementary feedings at that time, remains an elusive goal, and racial disparities are persistent with respect to initiation, continuation, and exclusivity of breastfeeding

[4]. For example, rates of breastfeeding initiation and of any breastfeeding at 6 and 12 months are almost ten percentage points lower for African-Americans than for the US population as a whole (73.7% vs. 84.1%, 47.8% vs. 58.3%, and 26.1% vs. 35.3%, respectively) [4]. Benefits of breastfeeding for women include reduced risk of breast and ovarian cancer, type 2 diabetes, and cardiovascular disease [5]. Benefits of breastfeeding for infants are evidence-based in both developing and developed countries, and include reduced all-cause mortality, reduced infectious disease frequency and severity, and reduced risk of sudden infant death syndrome [6]. Breastfeeding benefits are dose dependent, wide-ranging, and persist throughout the life course, increasing the urgency to achieve racial equity by improving breastfeeding rates for African-Americans and other minorities [7].

Smartphones, now widely used by the general population, may provide a way to address these inequities. About 96% of Americans own a cell phone and 81% own a smart phone [8].

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Racial disparities with respect to smart phone ownership are limited (80% of African-Americans own a smart phone), although both income and education disparities exist, with just 71% of those with income < \$30,000 and 76% of those who are not high school graduates owning a smart phone [8]. Access, use, and dependence on smartphones are increasing in the US [8]. “E-health” refers to health sector use of digital information technologies, and “m-health” is e-health use of mobile technologies including smart phones, tablets, and wearable devices. There is hope that m-health will improve population health [9], alongside concern that racial and social disparities could be widened through application of these technologies [10]. Systematic reviews have called for improved methods of evaluating quality and effectiveness of mobile phone applications [11], including for research-testing of applications to promote breastfeeding [12, 13].

Given known racial inequities with respect to breastfeeding rates [4, 7], and informed concern for equitable application of m-health technologies [10], the present study undertakes a scoping review of breastfeeding apps and of research on breastfeeding apps to determine the extent to which any are specifically focused on the needs of African-American mothers. Our research questions were (1) is there evidence-based literature on breastfeeding supportive apps that are directed toward African-American mothers, and (2) are there commercially available breastfeeding apps focused on the needs of African-American mothers? We sought to identify and map the available app-based breastfeeding support for African-American mothers to ascertain if gaps exist for this specific population. We chose this broad approach because much of e-health exists beyond published literature. The overarching goal of this scoping review is to pave the way for evidence-based m-health approaches that promote breastfeeding equity.

Methods

Review of Articles

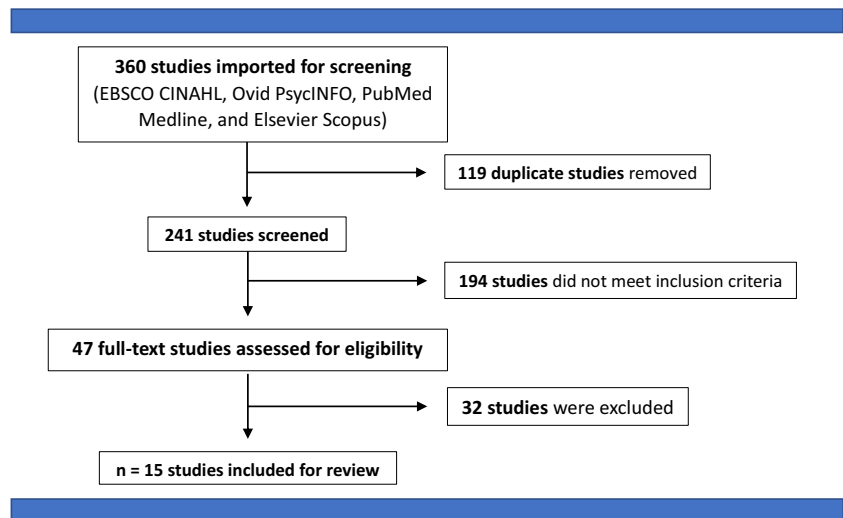
A systematic search was conducted for this scoping review. In June 2020, the databases EBSCO CINAHL, Ovid PsycINFO, PubMed Medline, and Elsevier Scopus were searched for the concepts of breastfeeding and mobile communication or applications. Search filters included the English language and the year 2000 to the present. Database controlled vocabulary and text word or title or abstract, or keywords with synonyms were used to generate search strategies. See Appendix 1 for details of each search and filters applied. Articles ($n = 360$) were exported into a Covidence database for evaluation and two authors reviewed full text to determine eligibility, as described below.

After removal of 119 duplicate studies, 241 peer-reviewed full texts in English language were reviewed for relevance, as depicted in the PRISMA diagram (Fig. 1), using inclusion and exclusion criteria. Relevant articles met the following inclusion criteria: (1) each described individual human subjects research studies utilizing any research design, (2) focused on app-based breastfeeding support, and (3) could be pertinent for African-American mothers. Articles that met exclusion criteria were either searched (systematic reviews) and placed in Appendix 2 for reader reference or discarded. Exclusion criteria follow here. Systematic reviews and meta-analyses ($n = 5$) were searched for additional relevant articles, and are referenced in Appendix 2. Articles that directly reviewed infant feeding apps ($n = 4$) were removed and are listed in Appendix 2. Articles examining (1) the use of SMS alone (short messaging service: a system that enables mobile phone users to send and receive text messages) for breastfeeding support or promotion ($n = 11$) or (2) breastfeeding apps for unidimensional purposes (e.g., breastfeeding and alcohol intake only) ($n = 4$) were excluded and are also listed in Appendix 2. Articles which were news reports rather than original studies, that described a single breastfeeding app without relevant outcomes, that described protocols or were only available as an abstract were excluded.

The remaining 15 articles were sorted into three categories, defined organically as article review proceeded: (1) Studies of the effect of a breastfeeding app on a defined breastfeeding outcome, (2) studies of the user experience with a breastfeeding app in which outcomes were related to characteristics of the app, and (3) studies of the process of breastfeeding app development. For each identified article, the following descriptors were abstracted: the setting (city, state if relevant, country), the study design and purpose, participants (number and race/ethnicity if described), outcome measures and assessment tools used, study results, and study conclusions (Tables 1, 2, and 3). We specifically sought to identify those studies in each grouping that were focused predominantly on African-American mother-infant dyads, described as all (100%), most ($\geq 50\%$), some ($1 < 50\%$), none, or information not available.

Review of Apps

We sought to identify apps that included breastfeeding support and were specifically relevant to African-American mothers. Our three inclusion criteria were broad and aimed at identifying any potentially relevant apps: we searched in the App Store (Apple) and Google Play Store for all apps (1) intended for parents, (2) focused on infant care generally or breastfeeding specifically, and (3) that were either free or if at cost, able to be accessed without charge. All others were excluded. We created a data extraction tool (available in Appendix Tables 5 and 6) that included the app goal (general baby care vs. breastfeeding specific support), technical aspects (cost, compatibility, app store rating, advertising presence, or

Fig. 1 Scoping review systematic search process

sponsored information), sharing ability (picture posting and social media or health provider linking ability), target audience (demographic characteristics by picture or description), breastfeeding-relevant content and features, and any features that normalize formula feeding (such as icons). We qualitatively described common features, unique features, and any novel approaches. Finally, we sought to identify if any app was both (1) breastfeeding supportive and targeted, and (2) clearly intended for African-American mothers as judged by relevant pictures and resources links.

Results

Articles

App Development Nine articles [14–22] including a total of 378 participants described the development or pre-development of a breastfeeding app (Table 1), of which 7 were conducted in the United States (US) and 2 in Australia. Focus groups, interviews, surveys, and prototype “walk-throughs” were the main study approaches; participant engagement focused on usability, desired features, and information. Two studies included only African-American participants, 3 included some (< 50%), and the remainder included none. Of the 2 studies with 100% African-American participants, one reported that study participants wanted to see more women who looked like themselves on the breastfeeding pages of the app [14], while the other found that participants were mixed about the potential appeal of an m-health app specifically for the African-American community [20].

User Experience Four articles [23–26] including 137 participants examined the user experience for breastfeeding apps, of which 2 were conducted in Australia [24, 26], one in Thailand [25], and one in the US [23]. Study approaches combined

open-ended questions or interview with Likert descriptors and usage quantitation to assess utility and usability of breastfeeding apps. Participants were asked to comment on features such as daily logging and tracking for feedings and other actions, a daily diary, ease of navigation, quality of information, and perceived usefulness. In the US-based study, 9 participants (15% of the study cohort) were African-American, while none (or not noted) was included in the Australian and Thai studies. Studies reported a range of user experiences from very helpful to burdensome, time-consuming (for using/navigating tracking features), and technically difficult. No comments or outcomes were specifically attributed to the African-American participants.

Breastfeeding Outcome Three studies [26–28] including 350 participants examined the effect of a breastfeeding app on breastfeeding outcomes, including any and exclusive breastfeeding at time points ranging from immediately postpartum to 6 months postpartum. Breastfeeding intention and, in one study, infant feeding attitudes were measured using validated self-reported health scales. Two studies took place in the US [27, 28] and one in Australia [26]; the US studies included, respectively, some (15%) and mainly (94%) African-American mothers. All concluded that the studied breastfeeding app was likely helpful and that additional study was needed. The study enrolling mainly African-Americans used apps featuring images of African-Americans and was aimed at this population.

Of the 15 relevant studies, one was represented in both the user experience and breastfeeding outcomes categories [26], and another study was represented in separate publications in these two categories [23, 27]. Overall, the proportion of African-American participants in these studies ranged from 100% (2 studies) to none (7 studies); 5 studies included any African-American participants and one did not report demographic information. Three studies were specifically aimed at

Table 1 Full text references for breastfeeding app development or app pre-development

Study	Setting, country	Study design, purpose, app featured	Participants (<i>n</i> , descriptors)	Methods	Outcomes measure, assessment tool	Results	Conclusion
[14]	Northern California Bay Area, USA; community setting	To describe the use of social media during the antepartum and postpartum periods among first-time African-American mothers and their support persons	14 Pregnant and postpartum AA women and <i>n</i> = 8 of their support persons [A]	Semi-structured interviews, community participant observations, field notes (43 in-person interviews); critical ethnography methodology	Used ethnographic approach—quotes and observations were summarized	Infant breastfeeding info from apps was “not memorable” and not recalled; participants wanted to see more women like themselves on BF pages	Social media is an important underutilized vehicle for information dissemination in this demographic
[15]	South central Texas, USA; community setting/WIC	To conduct the first stages of a user-centered design of a smartphone app to improve health behaviors among participants in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)	61 mothers (82% Hispanic-American, 7% AA) at WIC clinics [S]	Focus groups w/ prompted facilitators and barriers to health behaviors, current use of apps, and desired features in a WIC app; qualitative analysis of key themes and qualitative data analysis using QSR NVivo	Used themes/mentions to develop prototype app w/ 4 features for breastfeeding (library, timer, virtual assistant and growth chart)	Facilitators included access to information, support from healthcare practitioners and family. App use themes included texting/chatting, accessing information, tracking/focusing, planning/scheduling, sharing, gaming	An app has potential to improve health behaviors
[16]	South central Texas, USA; community setting/WIC	To determine acceptance of a mobile application to facilitate healthy behaviors among English- and Spanish-speaking Supplemental Nutrition Program for Women, Infants, and Children (WIC) participants (BF relevant features: tracking, growth, information, chat w/ LC or other moms), WIC app prototype	48 mothers (78% Hispanic-American) at WIC clinics [N]	User-led prototype evaluation of a nutrition education app. Conducted 6 focus groups; qualitative focus group research design to collect preferences and observations; qualitative analysis of key themes and qualitative data analysis using QSR NVivo	Qualitative data outcomes included user technology acceptance, user intention by feature, and participant smartphone habits	Participants were more willing to use an app if it was easy to navigate and included features that addressed specific challenges	Smartphone apps may be able to modernize and add value to WIC nutrition education
[17]	Pittsburgh, PA, USA; hospital setting	To determine women’s use of and preferences regarding technology* to obtain perinatal and breastfeeding support	146 postpartum women w/ late preterm infant who intended to breastfeed for 2 months (77% White, 11% AA) [S]	Surveys were administered orally, had both qualitative and quantitative queries	Descriptive statistics, bivariate analyses, Open-ended responses were coded for content in Atlas TI	Most women had smart phone access and sought breastfeeding information, women desired support, information and anticipatory guidance	Nature of technology represents an opportunity to deliver support and education
[18]	Bloomington IN, USA; community setting/WIC	To assess low-income mothers’ perceptions of their postpartum information needs and electronic information seeking	10 low-income women (80% White) [N]	Qualitative exploratory in-depth surveys which were recorded	Transcribed quotes, used content analysis to identify themes	Use of smartphones and mobile apps is common but there was a paucity of postpartum apps w/ info on BF, which was the most “pressing” issue identified	Highlights the need for development of prototype apps with postpartum BF content that teaches w/ evidence-based content
[19]	Wollongong NSW, Australia; community setting	To explore the process of converting a face to face lactation support program into a mobile health application, Milky Way app**	7 expectant women (3rd trimester) who intended to breastfeed (no AAs) [N]	A mixed-method approach was used in the development and evaluation process. Used “Persuasive System Design principles” an information technology process emphasizing persuasion	Combined qualitative information (quotes) and 16 Likert based questions	Participants were engaged with the information-based features, social support was least favored feature	“Using an application to deliver a successful face to face intervention across a mobile platform seems acceptable and feasible in the context of this pilot study.”
[20]		To identify ideal components of a m-health application and to		Used community-based participatory research and user-centered	Used open coding in NVivo 11 to organize data and then	Participants wanted text messaging, identified key	Usability test results were positive for prototype;

Table 1 (continued)

Study	Setting, country	Study design, purpose, app featured	Participants (<i>n</i> , descriptors)	Methods	Outcomes measure, assessment tool	Results	Conclusion
	District of Columbia, USA; community setting	determine usability of a prototype, KULEA-NET app prototype	50 pregnant and postpartum AA women [A]	design—focus groups + in-depth interviews	Tested prototype with System Usability Scale	themes (self-efficacy, parent-child attachment beliefs, social support, public breastfeeding and social desirability, and returning to work) and preferred features (local resources, support person access, baby care logs, identification of public breastfeeding venues, and peer discussions)	participants were mixed about the appeal of an m-health app specifically for the AA community
[21]	Columbia, MO, USA; community setting	Engage mothers in developing an app in 2 phases: Phase 1 involved concept generation, prototype development, and usability testing. Phase 2 focused on prototype redesign and usability testing. Mother's Milk Connection app [^]	Phase 1: 14 BF women (21% AA); Phase 2: 10 BF mothers (10% AA) [S]	A descriptive mixed-method approach with data collected using a demographic questionnaire, System Usability Scale (SUS), exit survey, and focus groups	Demographics and exit survey and SUS, a simple, reliable 10-item scale that measures perceived usability with responses ranging from strongly disagree to strongly agree; both qualitative and quantitative analysis	Thematic analysis of narrative data revealed user needs as education on how to breastfeed and manage challenges, reliable online resources, exposure to other breastfeeding mothers, and convenient access to professional support	Final features of the Mother's Milk Connection application included resources and education, peer support, automated activity tracking, and professional support via video conference
[22]	Australia; community setting	To develop the first evidence-based breastfeeding app targeted at men, Milk Man ^{^^}	18 (development) + 4 (walk through) new and expectant fathers (Australian) [N]	Social Change Theory and formative evaluation; focus groups, prototype walk through	Focus group themes for development, Mobile Application Rating Scale (MARS) for walk through; qualitative analysis of themes	Recommended functional areas, gamification, improvements; MARS score of 4.3/5	This is the first BF app for men

AA, African-American; A, 100% of participants were AA; M, 50% or more of participants were AA; S, 1–49% were AA; N, no African-American participants, NA, not available

* Apps used by participants included Baby Connect, I'm Expecting, Pregnancy Companion, Sprout, Mobile Mom, Medela iBrestfeed, Fit Pregnancy, Baby Bump, ^a BabyCenter/My Pregnancy Today, ^a BabyGaga, ^a The Bump, ^a What to Expect, ^a WebMD/WebMD Baby, ^a Contraction Timer, Kickme-Baby Kicks Counter, commercial companies (e.g., Similac, Enfamil, Gerber)

**Milkway is the first breastfeeding professional application developed using the Persuasive System Design model; it is not available in the consumer market

[^]Mother's Milk Connection was designed with the intent of developing an app ready for use in an efficacy trial; it is not available in the consumer market

^{^^}Milk Man was developed to be trialed as part of the Parent Infant Feeding Initiative (PIFI)

Table 2 Full text references for breastfeeding app user experience

Study	Setting, country	Study design, purpose, app featured; methodology	Participants (n, descriptors)	Duration	Outcomes measure, assessment tool	Result	Comment
[23]	Pittsburgh, PA, USA; hospital to suburban community setting	To describe the feasibility and acceptability of tracking BF behavior through a mobile phone app. ‘Baby Connect’*; prospective observational cohort study design	61 primiparous postpartum women (77% White, 15% AA) [S]	Birth—2 months postpartum	Quantified data input from participants; Asked open-ended questions to assess app acceptability/-experience	Participant and researcher experiences with the app ranged from helpful to too time-consuming, burdensome or technically difficult	Concluded that the data do not support the feasibility of a stand-alone app to track breastfeeding behaviors
[24]	Adelaide, South Australia; community setting	To describe mothers’ use and experiences of infant feeding apps with a feeding tracker component**; cross-sectional study with qualitative methods of semi-structured interview and thematic content analysis	9 mothers (no demographic description) who used 8 different apps [NA]	One time interview	Semi-structured individual interviews, continued till thematic saturation, inductive approach to coding	Tracking and visual data displays were reassuring, app complexity caused anxiety and mothers questioned info reliability	Overall mothers were positive and objective information provided by tracking of feeds increased confidence in BF
[25]	Bangkok, Thailand; community setting	The aim of this study was to evaluate the usability and usefulness of MoomMae ^, a mobile phone app designed to support breastfeeding women; pre-use interview and post-use survey+interview (qualitative and quantitative) study design.	21 BF women (Thai race, no AA) [N]	4 week period of use	Pre- and post-use structured interviews, w/ rating of usability (5 features) and usefulness (3 features) of the app on a 5 point Likert scale	Usability score 34.8/40 total; usefulness score 36.8/40; more positive than negative comments reported (approx. 5:1)	‘MoomMae has a great potential to be a useful self-management tool for breastfeeding mothers in Thailand...’
[26]	Southwest Victoria, Australia; rural community setting	To explore usability of the Breastfeeding Solutions app^^ among rural Australian breastfeeding women; prospective longitudinal self-report survey study design	46 BF women (96% Australian, 4% Filipino) [N]	Birth—6 months postpartum	Demographics and detailed usage questions (frequency of use, features used) at 3 and 6 months, w/ comments	93.5% (29 of 31) rated the app favorably, 96.8% (30 of 31) found the app helpful and 87.1% (27 of 31) would recommend to other BF mothers	Highly motivated women used the app, an Australian app may be optimal

AA, African-American; A, 100% of participants were AA; M, 50% or more of participants were AA; S, 1–49% were AA; N, no African-American participants; NA, not available

*The *Baby Connect* app is described in Appendix Tables 5 and 6

**Apps used by participants included *Baby Feed Timer*, *Baby Connect*, *Baby Tracker*, *MammaBaby*, *Parent Love*, *Feed Baby* (each described in Appendix Tables 5 and 6), *Feeding Pro*, and *Total Baby* (neither is available in the App Store or Google Play Store)

^MoomMae is available in the Google Play store but all text is in Thai Language only

^^The *Breastfeeding Solutions* app is described in Appendix Tables 5 and 6

Table 3 Full text references for breastfeeding app effectiveness

Study	Setting, country	Study design, purpose, app featured; methodology	Participants (n, descriptors)	Duration	BF outcomes measure, assessment tool	Result	Comment
[27]	Pittsburgh PA, USA; hospital to suburban community setting	To describe breastfeeding behaviors via a commercial infant feeding app*; no randomization to app use/non-use; prospective observational cohort study design	61 primiparous postpartum women (77% White, 15% AA) [S]	Birth—2 months postpartum	App use/non-use; BF problems, Exclusive and any BF at 2 and 8 weeks; Iowa Infant Feeding Attitude Scale, NIH PROMIS scale	38 (62%) provided any data via the app; study identified declining exclusive BF and less at-breast BF w/ time; 81% had any BF problem	App served as a successful and largely effective data capture tool for more than half the participants
[28]	Cleveland OH, USA; urban hospital setting	To test the feasibility and acceptability of 2 I-Pad interventions** to increase exclusive BF postpartum, longitudinal survey study with follow-up chart review, not randomized; longitudinal survey with follow-up chart review study design	243 expectant women (94% AA) [M]	One time intervention, followed from prenatal 28 weeks through postpartum in-hospital	Immediate exclusive BF (EBF) intent post intervention, feasibility/acceptability, EBF in-hospital postpartum	Immediate BF intent did not change, app was feasible and accepted, found a significant increase in the proportion of women who originally did not intend EBF, but then did EBF in-hospital postpartum.	Feasibility and preliminary results are promising, needs larger RCT to confirm finding
[26]	Southwest Victoria, Australia; rural community setting	To describe feeding outcomes w/ use of the Breastfeeding Solutions app^ among rural Australian breastfeeding women; prospective longitudinal self-report survey study design	46 BF women (96% Australian, 4% Filipino) [N]	Birth—6 months postpartum	Any and exclusive BF at 3 and 6 months, BF history, confidence, intention and BF desirability at baseline	6-month survey: 79% (23/29) were breastfeeding, 3-month survey: 69% (20/29) were BF	Rate of continuing to BF at 6 months was > recent rates in southwest Victoria suggesting the app was helpful

AA, African-American; A, 100% of participants were AA; M, 50% or more of participants were AA; S, 1–49% were AA; N, no African-American participants; NA, not available

*The *Baby Connect* app is described in Appendix Tables 5 and 6

**Included the Breastfeeding Champion module of the coffective app (<https://coffective.com/training-and-tools/>) and an investigator-initiated app not commercially available. Both are available in full text within the reference

^The *Breastfeeding Solutions* app is described in Appendix Tables 5 and 6

the breastfeeding experiences of African-American mothers: two focused on development of a population-specific breastfeeding app and one tested breastfeeding outcomes with use of an app.

Apps

Of 77 apps that met study inclusion criteria, 58 (75%) were breastfeeding specific and 19 (25%) included other topics and had breastfeeding information in the context of general infant care (details in Appendix Tables 5 and 6, summary presented in Table 4). The majority of apps 65 (84%) were free; 11 (14%) had a free version with cost for additional features such as consultation, additional information, or advertisement-free content. Most (39, 51%) were both iPhone and Android compatible, 35 (45%) were iPhone compatible only, and 3 were Android only. The mean rating for the 72 rated apps was 4.3 (range 2.7–5.0, median—4.6), though the total number of reviews per app ranged widely from 3 to > 200,000. Half (35, 45%) had no advertising, and for 11 (14%) we were unable to determine due to limited access without payment. Twenty-nine apps (38%) had a function to share with a partner, synchronize across phones or export data, 39 (51%) did not, and for 9 (12%) this could not be determined. Just 8 apps (10%) had built in linkage to external social media (e.g., Facebook), linkage to an app-specific forum or community of mothers (internal social media), or ability to connect to a health provider/lactation specialist, and for 10 (13%) linkage could not be assessed.

The main audience per search inclusion criteria was mothers, and targeted race/ethnicity was deduced from pictures and emojis within the app. Of all apps, the majority (47, 61%) had pictures and emojis solely representing white infants and mothers, fewer (10, 13%) included diverse races/ethnicities (defined as 2 or more images representing 2 or more races/ethnicities), one had only African-Americans pictured, one had solely images best interpreted as Asian, and the remainder had no images. Forty-six apps (60%) provided the ability to personalize by adding pictures of one's own infant. Breastfeeding informational content was available on 28 apps (36%) either directly or through linking to additional sites. Seventeen apps (22%) used only a bottle icon to indicate feeding in general, with no separate breastfeeding or breast milk icon. Most apps (58, 75%) included functions to track or log infant feedings. Unique potentially parent-friendly features on several apps included hands-free and stopwatch features to time feeds that ran even during other phone uses, embedded videos demonstrating breastfeeding technique, diary features and logging for maternal mood and nipple changes, embedded forums that turned the app into a social media site for users, and motivational messaging features.

Table 4 App features summary

Features.	Apps (<i>n</i> = 77)
Content	
General infant care	19 (25%)
BF-specific	58 (75%)
Compatibility	
iPhone	35 (45%)
Android	3 (4%)
Both	39 (51%)
Cost	
Free	65 (84%)
Paid	12 (16%)
Rating	
Greater than 4	63 (82%)
Less than 4	9 (12%)
Not rated	5 (6%)
Advertising or sponsorship	
Yes	31 (40%)
No	35 (45%)
UD	11 (14%)
Sharing or exporting	
Yes	29 (38%)
No	39 (51%)
UD	9 (12%)
Links to social media/provider	
Yes	8 (10%)
No	59 (77%)
UD	10 (13%)
Target population (stated)	
Moms/mothers (any) only	30 (39%)
Parents (or mom and partner)	34 (44%)
Target population (pictures)	
White only	47 (61%)
Black/AA	1 (1%)
Asian	1 (1%)
Hispanic	0
Racially diverse	10 (13%)

UD, undetermined (app was inaccessible due to cost or phone incompatibility)

In summary, of the 77 apps reviewed, we identified one app that was both breastfeeding-focused and targeted for African-Americans as assessed by picture predominance.

Discussion

We completed a scoping review that included scientific articles describing individual any-design human subjects research that focused on app-based breastfeeding support

pertinent for African-American mothers. We identified 15 relevant articles, of which just three (20%) included either mainly ($\geq 50\%$) or all African-American participants and were specifically aimed at the breastfeeding experiences of African-American mothers. This result suggests a knowledge and research gap in the literature exists that represents a racial health disparity: we would expect a larger proportion of dedicated research given the current racial gap in breastfeeding rates between non-minorities and African-Americans.

We also reviewed current iPhone and Android infant feeding apps for relevance to African-American mothers. Of the 77 infant feeding apps reviewed, only one app was both breastfeeding-focused and targeted toward African-Americans as assessed by picture predominance. This finding suggests there is also a racial disparity and gap in the consumer market, since 12.7% of the US population is African-American [29]. We conclude that there are meaningful racial disparities in both scientific research and consumer product availability with respect to breastfeeding supportive apps for African-American mothers.

Five systematic review articles [11, 30–33] on the topics of e-technology noted that a broad variety of different e-technology and m-health products were available beyond apps. Reviews concluded that improved standards and validated methods of evaluating e-technology products are needed [11], that improved interactivity with the mother and ability for greater content personalization is desirable [31], and that e-health systems often do not involve important stakeholders such as partners [33]. One systematic review of multiple types of e-health applications that included texting, SMS, and web-based programs with electronic prompts (16 studies, 5505 participants), but excluded phone apps, concluded that certain breastfeeding outcomes (e.g., breastfeeding initiation) significantly improved over the spectrum of different applications [30]. None of the reviews addressed the issue of participant race or ethnicity.

Among four reviews of breastfeeding apps, three did not consider the race/ethnicity of the intended audience [13, 34–36]. However, Sidhu et al. created a “diversity score,” and viewed pictures on the 13 (of 41 apps reviewed) that provided educational breastfeeding content. They counted 48 total pictures of breastfeeding dyads, of which just 6 (12.5%) were of a non-white woman and infant. The authors concluded “few apps...promote breastfeeding self-efficacy... and educational content with images of diverse caretakers... those from minority...groups, have limited options when selecting a breastfeeding app” [35]. This conclusion aligns fully with our findings from the breastfeeding app review conducted here.

Our scoping review has limitations. The total number of articles identified that met criteria for review was just 15, so the number of relevant publications limits the review.

Although we combined actual app review with article review, it is possible that we missed ongoing work or apps outside the published literature or the mainstream app stores. To mitigate this, we searched publicly accessible websites of organizations that specifically support breastfeeding for African-American women, but this method of search cannot be considered systematic and did not in fact yield any additional apps or research.

This scoping review has clinical implications for health providers. Practitioners can use this information to focus their breastfeeding guidance for African-American mothers. Understanding that there is not a specific commercially available mobile phone app for African-American mothers aiming to breastfeed, providers can explain frankly the potential features and limitations of available apps for mothers who ask. With recognition of this gap in e-health support for African-American mothers seeking to breastfeed, providers can take advantage of every contact opportunity to personalize their care by eliciting the mother’s preferences for resources and social supports that would be most helpful to her breastfeeding. Given that current consumer market research and development in support of this subpopulation of mothers is lacking, the intentionality of providers to focus on patient level empathic care, education, and advocacy in order to increase breastfeeding rates among African-American women is of heightened importance.

In summary, there appears to be a meaningful racial disparity with respect to app-based breastfeeding support for African-American mothers. Both a scoping review of the literature and a review of available infant feeding apps reached a similar conclusion. This gap will be critical to close, because low US rates of breastfeeding initiation, continuation, and exclusivity among African-Americans, in comparison to non-minorities, are a glaring health inequity [4, 7]. Exclusive breastfeeding through 6 months of age, with continued breastfeeding as long as desired, is recommended by multiple professional organizations [1–3], because breastfeeding is associated with dose-dependent reductions in both infection-related and all-cause mortality and sudden infant death syndrome among infants, and in breast cancer, ovarian cancer, cardiovascular risk, and type 2 diabetes among mothers. [5, 6]. In addition, billions in maternal and infant health dollars for mothers and children could be saved if full breastfeeding per recommendations could be achieved population wide [37]. Access to evidence-based breastfeeding apps specifically targeted toward African-American mothers and parents has potential to mitigate an important health disparity, and this will be a consequential area for future development and research.

Code Availability See [Appendix 1](#) for this information.

Authors' Contributions Ms. Mieso reviewed the infant feeding apps and articles, created data tables, and aided in drafting and revising the manuscript. Ms. Neudecker conducted the systematic search for the scoping review, and aided in drafting and revising the manuscript. Dr. Furman also reviewed the articles, and drafted and revised the manuscript. All authors reviewed and approve of the final manuscript as written.

Data Availability The search terms for the review are available in [Appendix 1](#). Full text for all articles are publicly available via journal publishers or PubMed.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

Appendix 1. Database search strategies by source

PubMed Medline

Search: (“Breast Feeding”[Mesh]) OR (((breast feed*[Text Word]) OR (breastfeed*[Text Word]) OR (breast fed*[Text Word]) OR (breastfed*[Text Word]))) AND (((((((“Cell Phone”[Mesh]) OR ((cell phone*[Text Word]) OR (cellphone*[Text Word]) OR (cellular phone*[Text Word])) OR ((smartphone*[Text Word]) OR (smart phone[Text Word])) OR ((mobile phone*[Text Word])) OR ((app[Text Word]) OR (“mobile applications”[MeSH Terms]) OR ((app[Text Word]) OR (apps[Text Word]))) OR (mobile application*[Text Word]) OR (phone application*[Text Word])) Filters: English, from 2000 to 2020 **132 Results**

CINAHL

#Query Limiters/Expanders Last Run Via Results

S15 S6 AND S14 Limiters - Published Date: 20000101-20201231; English Language

Expanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - **CINAHL with Full Text86**

S14 S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 Expanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 20,035

S13 TI smart N2 phone* OR AB smart N2 phone*Expanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text667

S12 TI cell* N2 phone* OR AB cell* N2 phone* OR TI mobile N2 phone* OR AB mobile N2 phone*Expanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text5,367

S11 TI apps OR AB appsExpanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text7,168

S10 TI Mobile Application* OR AB Mobile Application*Expanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text1,628

S9 TI phone application* OR AB phone application*Expanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text333

S8 (MH “Mobile Applications”) Expanders - Apply equivalent subjects

Search modes - Boolean/PhraseInterface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 7,370

S7 (MH “Cellular Phone”) OR (MH “Smartphone”)Expanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text4,593

S6 S1 OR S2 OR S3 OR S4 OR S5Expanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 32,744

S5 TI breast fed OR AB breast fed Expanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 1,208

S4 TI breastfeed* OR AB breastfeed*Expanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 19,112

S3TI breast feed* OR AB breast feed*Expanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 4,140

S2(MH "Breast Feeding Promotion") OR (MH "Attitude to Breast Feeding")Expanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 5,070

S1(MH "Breast Feeding+")Expanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 24,784

Database(s): APA PsycInfo 1806 to June Week 12020

Search Strategy:

Searches Results

1 exp Breast Feeding/3580

2 (breast adj2 fed*).tw.337

3 (breast adj2 feed*).tw.1798

4 1 or 2 or 34262

5 exp Mobile Phones/5254

6 exp Smartphones/1562

7 (cell* adj2 phone*).tw.2046

8 (smart adj2 phone*).tw.582

9 (mobile adj2 phone*).tw.3617

10 mobile applications/817

11 (mobile adj2 application*).tw.1340

12 (phone adj2 application*).tw.193

13 (apps or application*).tw.180786

14 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13187494

15 4 and 1469

16 limit 15 to (all journals and english language and yr="2000 -Current") 40

Scopus

TITLE-ABS-KEY(breast W/2 feed*) OR TITLE-ABS-KEY(breast W/2 fed) AND TITLE-ABS-KEY(cell* W/2 phone*) OR TITLE-ABS-KEY(smart W/2 phone*) OR TITLE-ABS-KEY(Mobile W/2 phone*) OR TITLE-ABS-KEY(Mobile W/2 application*) OR TITLE-ABS-KEY(phone W/2 app*) OR TITLE-ABS-KEY(mobile W/2 app*) OR TITLE-ABS-KEY(cell W/2 app*) PUBYEAR >1999 AND (LIMIT-TO (LANGUAGE,"English")) **101 results**

Appendix 2. Studies excluded but of interest by topic

Meta-analyses and Systematic Reviews

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3. McKay F, Cheng C, Wright A, Shill J, Stephans H, Uccellini M. Evaluating mobile phone applications for health behaviour change: A systematic review. *Journal of Telemedicine and Telecare* 2018, Vol. 24(1) 22–30 <https://doi.org/10.1177/1357633X16673538>
4. Diniz CM, Leal LP, Guedes TG, Linhares FM, Pontes CM. Contribuições dos aplicativos móveis para a prática do aleitamento materno: revisão integrative [translated version accessed]. *Acta Paul Enferm.* 2019;32(5):571–7.
5. Tang K, Gerling K, Chen W, Geurts L. Information and Communication Systems to Tackle Barriers to Breastfeeding: Systematic Search and Review *J Med Internet Res.* 2019 Sep; 21(9): e13947. Published online 2019 Sep 27. <https://doi.org/10.2196/13947>

Reviews of Infant Feeding Apps

1. Cheng H, Tutt A, Llewellyn C, Size D, Jones J, Taki S, Rossiter C and Denney-Wilson E. Content and Quality of Infant Feeding Smartphone Apps: Five-Year Update on a Systematic Search and Evaluation. (*JMIR Mhealth Uhealth* 2020;8(5):e17300) <https://doi.org/10.2196/17300>
2. Schindler-Ruwisch JM, Roess Am, Robert RC, Napolitano M, Chiang S. Social Support for Breastfeeding in the Era of MHealth: a Content Analysis. *J Hum Lact* 2018; 34:543–555. <https://doi.org/10.1177/0890334418773302>.

3. Sidhu S, Ma K, Sadovnikova A. Features and Educational Content Related to Milk Production in Breastfeeding Apps: Content Analysis Informed by Social Cognitive Theory. *JMIR Pediatr Parent* 2019;2(1):e12364. <https://doi.org/10.2196/12364>
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Infant Feeding Websites and Apps: A Systematic Assessment of Quality and Content. *Interact J Med Res* 2015;4(3):e18. <https://doi.org/10.2196/ijmr.4323>

Breastfeeding Support using Short Message Service (SMS)

1. Martinez-Brockman JL, Harari N, Pérez-Escamilla R. Lactation Advice through Texting Can Help: An Analysis of Intensity of Engagement via Two-Way Text Messaging. *J Health Commun.* 2018;23(1):40–51. <https://doi.org/10.1080/10810730.2017.1401686>.
2. Palacios C, Campos M, Gibby C, Meléndez M, Lee JE, Banna J. Effect of a Multi-Site Trial using Short Message Service (SMS) on Infant Feeding Practices and Weight Gain in Low-Income Minorities. *J Am Coll Nutr.* 2018;37(7):605–613. <https://doi.org/10.1080/07315724.2018.1454353>
3. Gallegos D, Russell-Bennett R, Previte J, Parkinson J. Can a text message a week improve breastfeeding?. *BMC Pregnancy Childbirth.* 2014;14:374. Published 2014 Nov 6. <https://doi.org/10.1186/s12884-014-0374-2>
4. Patel A, Kuhite P, Puranik A, Khan SS, Borkar J, Dhande L. Effectiveness of weekly cell phone counselling calls and daily text messages to improve breastfeeding indicators. *BMC Pediatr.* 2018;18(1):337. Published 2018 Oct 30. <https://doi.org/10.1186/s12887-018-1308-3>
5. Wu Q, Huang Y, van Velthoven MH, Wang W, Chang S, Zhang Y. The effectiveness of using a WeChat account to improve exclusive breastfeeding in Huzhou County Qinghai Province, China: protocol for a randomized control trial. *BMC Public Health.* 2019;19(1):1603. Published 2019 Dec 2. <https://doi.org/10.1186/s12889-019-7676-2>
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Unidimensional Breastfeeding apps

1. Simpson E, Garbett A, Comber R, Balaam M. Factors important for women who breastfeed in public: a content analysis of review data from FeedFinder. *BMJ Open.* 2016;6(10):e011762. Published 2016 Oct 24. <https://doi.org/10.1136/bmjopen-2016-011762>
Feedfinder (BF in public)
2. Garcia-Gómez JM, de la Torre-Díez I, Vicente J, Robles M, López-Coronado M, Rodrigues JJ. Analysis of mobile health applications for a broad spectrum of consumers: A user experience approach. *Health Informatics Journal.* 2014, Vol. 20(1) 74–84.
Lactation app (medications and BF)
3. White BK, Burns SK, Giglia RC, Scott JA. Designing evaluation plans for health promotion mHealth interventions: a case study of the Milk Man mobile app. *Health Promot J Austr.* 2016;27(3):198–203. <https://doi.org/10.1071/HE16041>
Design of a lactation app for men – describe the design partnership not the app
4. White B, White J, Giglia R, Tawia S. Feed Safe: a multidisciplinary partnership approach results in a successful mobile application for breastfeeding mothers. *Health Promot J Austr.* 2016;27(2):111–117. Published 2016 May 30. <https://doi.org/10.1071/HE15114>
Feed Safe app (educates about alcohol intake and BF)

Appendix 3. Summary of features of individual apps

Table 5 App technical aspects and target audience

App name	General infant care vs. BF-specific	Compatibility	Cost	App store rating (number of reviewers)	Advertising within app	Sharing or exporting	Linking to provider or social media	Target population—stated	Target population—photos
Baby Feed Timer, breastfeeding	BF	Both	\$8.99	4.8 (13K)	No	Yes (sync devices and export function)	Social media	Breastfeeding mothers	White babies
Baby Tracker - Newbom Log	BF	Both	Free	4.8 (101K)	No	Yes (sync devices and export function)	None	New parents	White babies
Glow Baby: Newbom Tracker Log	BF	Both	Free (premium version = \$29.99/3 months)	4.7 (8.7K)	Yes	Yes (sync devices)	None	New parents	Majority white, mixed race babies
MyMedela Baby Tracker	BF	Both	Free	4.5 (1.4K)	Ads: No Sponsor: Medela	Yes (export function)	None	None	White babies
Baby Breastfeeding Tracker	BF	Both	Free	4.3 (1.4K)	Yes (premium is ad free)	Yes (export function)	Communicate with provider	Breastfeeding mothers	White babies
Ovia Parenting and Baby Tracker	General	Both	Free	4.6 (2.3K)	Ads: Yes Sponsor: Ovia Health	Yes (can give admin access)	No	Parents	White babies
MammaBaby Breast feeding LactApp	General	Both	Free (full version = \$3.99)	4.3 (682)	No	No	Social media	New parents	White babies
Sprout Baby (Baby Tracker)	General	iPhone	Free (premium version = \$7.99)	5.0 (7)	No	No	No	Mothers	Racially diverse
Breastfeeding Hub	BF	iPhone	Free	4.8 (19K)	No	No	No	Parents	White babies
Pumping Work	BF	iPhone	Free	NR	No	No	No	Pumping moms	White babies and mothers
Huckleberry: Baby and Child	General	Both	Free	4.6 (367)	Yes	Yes (export function)	No	Breastfeeding moms and their families	White babies
Hatch Baby	BF	Both	Free	4.9 (2.8K)	No	No	No	Parents of young children	White baby animations
Fast Breastfeeding Log- Baby Nursing Time Baby Tracker!	BF	Both	Free	4.8 (4.7K)	Sponsor: Hatch Baby Grow smart changing pad	Yes (export function)	No	Moms	White babies
Feed Baby -Breastfeeding App	BF	iPhone	Free	NR	Yes	No	Social Media	Not stated	White hands
Milk Stash: Breast Feeding App	BF	Both	Free	4.9 (861)	Yes	Yes (export function)	No	Mom, dad, relative	White babies
Baby Feeding Tracker and Log	BF	Both	Free	4.6 (7.5K)	Yes	Yes (export and sync function)	No	New parents	White babies
Baby Feeding Tracker and Log	BF	iPhone	Free	4.5 (440)	No	Yes (sync devices)	No	Pumping moms	None
Serene Breastfeeding Timer Breast Feeding App	BF	Both	Free	5.0 (14)	Yes	Yes (export function)	No	Parents	White baby icon
	BF	iPhone	Free	4.1 (11)	No	No	No	New parents	None
	BF	iPhone	\$4.99	4.4 (7)	UD	No	No	New moms	White babies

Table 5 (continued)

App name	General infant care vs. BF-specific	Compatibility	Cost	App store rating (number of reviewers)	Advertising within app	Sharing or exporting	Linking to provider or social media	Target population—stated	Target population—photos
BreastFeeding Friend	BF	iPhone	Free	3.7 (3)	No	No	No	New moms	White breasts
Breastfeeding by AZoMedical	BF	iPhone	Free	NR	Sponsor: AZoNetwork	No	No	New moms	White babies, mothers, physicians
Breast Beginnings	BF	iPhone	Free	4.5 (6)	Ads: No	No	No	Mothers	Majority white
Colfective	BF	Both	Free	2.7 (10)	Sponsor: University of Kentucky	Yes (invite users to use app with you)	No	Pregnant women and her supporters	African-American mothers and fathers
Text4baby	General	Both	Free	4.5 (61)	No	No	No	Pregnant women or new moms	Racially diverse babies and parents
Small Moments Big Impact	General	iPhone	Free	4.8 (14)	No	No	No	Mothers	Racially diverse parents, babies and providers
BoobieTime Breast Feeding Timer	BF	iPhone	\$0.99	4.8 (165)	UD	No	No	Breastfeeding mothers	None
Pump Log	BF	iPhone	Free (unlimited version = \$8.99)	4.6 (456)	No	Yes (export function)	No	Exclusive pumpers	None
Breastfeeding app+	BF	iPhone	Free	4.4 (21)	Yes	No	No	Moms	White emojis
BabyTime	BF	Both	Free	4.7 (198)	Yes	No	No	Mothers and fathers	Racially diverse
BabySparks	General	Both	Free	4.7 (11K)	Yes	No	No	Mother, father, grandparents, babysitting, aunt, uncle	White
Baby Tracker.	General	Both	\$2.99/month	4.5 (1.1K)	No	No	No	Women trying to conceive, pregnant women, moms, dads	White babies
Baby Tracker - My Baby	BF	iPhone	Free	4.8 (512)	No	No	No	Not specified	White babies
Baby Care (Baby Tracker and Breast Feeding)	BF	Both	Free	4.8 (224)	No	Yes (export function)	No	Moms	None
Baby +	General	Both	Free	4.7 (6K)	No	No	No	Moms and dads	Majority white
Breast Baby: Newborn Tracker	BF	iPhone	Free	4.9 (115)	No	Yes (export function)	No	Parents	None
Time for baby - Breastfeeding	BF	iPhone	Free	4.6 (42)	Yes	Yes (export function)	No	New parents	None
Baby's Journal	BF	iPhone	Free	4.8 (145)	No	No	No	New parents	White animations
WebMD Baby	General	Both	Free	4.3 (514)	Ads: Yes	Yes (sync devices)	No	Parents	Majority white babies
Breastfeeding Newborn tracker	BF	iPhone	Free	4.7 (197)	Sponsor: WebMD	No	No	Moms	Racially diverse animated pictures
Babio - Baby Activity Tracker	BF	iPhone	Free	4.5 (611)	No	No	No	New parents	White emojis
Nara Baby Tracker	BF	Both	Free	4.7 (54)	No	Yes (invite users to use app with you)	No	Parents	White emojis
What To Expect	General	Both	Free	4.8 (236K)	Yes	No	No	Moms-to-be	White babies
PlyoLog - Baby Feed Tracker	BF	Both	Free	4.9 (580)	Yes	Yes (export function)	No	Parents (moms and dads)	White animations
BabyFeed	BF	Both	Free	4.6 (177)	Yes	Yes (invite users to use app with you)	No	New parents	White babies

Table 5 (continued)

App name	General infant care vs. BF-specific	Compatibility	Cost	App store rating (number of reviewers)	Advertising within app	Sharing or exporting	Linking to provider or social media	Target population—stated	Target population—photos
Mother's Milk	BF	Both	Free	4.8 (8)	Ads: No Sponsor: UC San Diego Health	No	No	Mothers and partners	White
Nursing Log	BF	iPhone	Free	4.5 (25)	No	Yes (export function)	No	Breastfeeding mothers	None
Similac Baby Journal	BF	Both	Free	3.3 (28)	Ads: No Sponsor: Similac	Yes (export function)	No	Moms and dads	None
Baby Diary Pumping	BF	iPhone	Free	4.7 (6)	Yes	No	No	Mothers	Racially diverse
Nursing Notebook theAsianparent	BF	iPhone	Free	3.5 (11)	No	No	No	Breastfeeding mothers	None
Circle by St. Joseph Health	General	Both	Free	4.8 (142)	No	No	Private parent social network	Parents and pregnant parents-to-be	Asian
Awesome Baby Tracker	General	iPhone	Free	4.8 (193)	Ads: No Sponsor: St. Joseph Health	Yes (invite users to use app with you)	Find and communicate with provider	Moms and moms-to-be	Racially diverse
ParentLove: Baby Tracker	BF	iPhone	Free (premium version = \$7.99)	4.8 (519)	No	No	No	Parents	White
SuperMama	BF	Both	Free	4.9 (105)	No	Yes (invite users to use app with you)	No	Moms	None
Eat Sleep: Simple Baby Tracker	BF	Both	Free	4.8 (18)	No	No	No	New moms and new parents	White
Answered.	BF	iPhone	Free (additional features \$0.99)	4.3 (386)	No	Yes (export function with paid version)	No	Moms and parents	White
Nod Baby Sleep Coach and Tracker	General	iPhone	Free	4.2 (14)	Ads: No Sponsor: Hatch Baby	No	No	Parents	Racially diverse
Baby Loggy - newborn care log	BF	Both	Free (premium version = \$4.99)	3.8 (253)	No	No	No	Parents	White emojis
BabyDiary - The Baby Tracker	BF	iPhone	Free (unlimited version \$2.99)	4.7 (199)	No	No	No	Parents	White emojis
Baby Feeding Log Kinedu	BF	iPhone	Free	4.7 (73)	No	No	No	Moms	White emojis
Pacify Circle by Providence	BF	iPhone	Free	4.8 (1.5K)	Yes	No	No	Moms	White emojis
Mamava	BF	Both	Free (premium version \$14.99/month)	4.5 (2.5K)	No	No	No	Moms	White emojis
Pregnancy Tracker + Countdown to Baby Due Date BabyCenter	BF	Both	\$59.00/month	4.9 (808)	UD	UD	UD	Moms	Racially diverse emojis
Tinyhood	BF	Both	Free	4.8 (864)	Ads: No Sponsor: Providence Health	Yes (users can use the app with you)	Find and communicate with provider	Moms and moms-to-be	Racially diverse
Baby Connect Latch ME	BF	Both	Free	4.6 (438)	Ads: No Sponsor: Mamava	No	No	Breastfeeding moms	White women
Breastfeeding Central	BF	Both	Free	4.8 (68K)	Yes	No	No	Parents	White moms: non-white emojis
	General	Both	Free (\$49 for video phone consultations; \$19 for messaging feature)	3.8 (17)	No	No	No	Parents	White moms and babies
	BF	Both	\$4.99	4.9 (3.8K)	UD	UD	UD	Busy moms	White babies
	BF	iPhone	\$0.99	3.0 (3)	UD	UD	UD	Moms	White moms and babies
	BF	iPhone	\$3.99	3.9 (41)	UD	UD	UD	Parents	White moms and babies

Table 5 (continued)

App name	General infant care vs. BF-specific	Compatibility	Cost	App store rating (number of reviewers)	Advertising within app	Sharing or exporting	Linking to provider or social media	Target population—stated	Target population—photos
Littlefeed	BF	iPhone	\$2.99	4.6 (11)	UD	UD	UD	New parents	None
Noa Breastfeeding Timer	BF	iPhone	\$0.99	NR	UD	UD	UD	Moms	None
Breastfeeding Tracker by bf	BF	iPhone	\$0.99	4.4 (175)	UD	UD	UD	Modern moms	White moms and babies
Mother's Milk Messaging	BF	Android	Free	NR	UD	UD	UD	Parents	White emojis
Baby Care – track baby growth!	BF	Android	Free (ad-free version \$1.99)	4.5 (17.5)	UD	Yes (export function)	Social media	Parents	White emojis
Nancy Mohrbaeher Breastfeeding Solutions	BF	Both	\$4.99	3.0 (6)	Ads: No Sponsor: Nancy Mohrbaeher	UD	UD	Moms	White emoji
Breastfeeding- Baby Tracker	BF	Android	Free	4.9 (7K)	No	Yes (sync devices)	UD	Moms	White baby

Table 6 Breastfeeding and formula feeding features and user experience

App name	Breastfeeding info (Y/N)	Prenatal breastfeeding info (Y/N)	Feeding tracker: BF, F, P	Other tracking: S, G, V	Feeding stopwatch	Formula/ bottle icons	Singleton or > 1 baby (Y/N)	Able to add pictures?	Our user rating (1–5)
Baby Feed Timer, breastfeeding	No	No	BF, F, P	S, G, V	Yes	Yes	> 1	Yes	2
Baby Tracker - Newborn Log	No	No	BF, F, P	S, G, V	Yes	Yes	> 1	Yes	3
Glow Baby: Newborn Tracker Log	Yes	No	BF, F, P	S, G, V	Yes	Yes	> 1	Yes	3
MyMedela Baby Tracker	Yes	Yes	BF, F, P	S, G	No	No	> 1	Yes	3
Baby Breastfeeding Tracker	No	No	BF, F, P	S, G, V	Yes	Yes	(> 1 with premium)	Yes	3
Ovia Parenting and Baby Tracker	Yes	No	BF, F, P	None	Yes	Yes	> 1	Yes	2
MammaBaby Breast feeding	No	No	None	None	N/A	N/A	N/A	Yes	2
LactApp	No	Yes	BF, P	S, G	Yes	No	> 1	Yes	3
Sprout Baby (Baby Tracker)	No	No	BF, P	S	Yes	Yes	> 1	Yes	2
Breastfeeding Hub	Yes	No	None	None	N/A	No	N/A	No	3
Pumping Work	No	No	P	None	Yes	Yes	N/A	No	2
Huckleberry: Baby and Child	No	No	BF, F, P	S, G	Yes	Yes	> 1	No	3
Hatch Baby	No	No	BF, F, P	S, G	Yes	Yes	> 1	Yes	3
Fast Breastfeeding Log- Baby Nursing Time	No	No	BF, F, P	S	Yes	No	N/A	No	1
Baby Tracker!	No	No	BF, F, P	S, G, V	Yes	Yes	> 1	Yes	3
Feed Baby - Breastfeeding App	No	No	BF, F, P	S, G, V	Yes	Yes	> 1	Yes	3
Milk Stash: Breast Feeding App	No	No	P	None	Yes	Only in app icon	N/A	No	3
Baby Feeding Tracker and Log	No	No	BF, F, P	S, G, V	Yes	No	N/A	No	3
Serene Breastfeeding Timer	Yes	No	BF, F, P	S, G, V	Yes	Yes	> 1	Yes	3
Breast Feeding App	Yes	No	BF, F, P	None	Yes	No	N/A	No	2
BreastFeeding Friend	Yes	Yes	None	None	N/A	No	N/A	No	2
Breastfeeding by AZoMedical	Yes	Yes	BF, F	None	Yes	No	N/A (cannot actually add baby)	No	2
Coffective	Yes	Yes	None	No	N/A	No	N/A (cannot actually add baby)	No	3
Text4baby	Yes	Yes	None	No	N/A	No	N/A (cannot actually add baby)	No	3
Small Moments Big Impact	Yes	No	None	No	N/A	No	Singleton	Yes	3
BoobieTime Breast Feeding Timer	No	No	BF, F, P	S	Yes	No	> 1	UD	NR
Pump Log	No	No	P	None	Yes	No	> 1	No	3
Breastfeeding app+	No	No	BF, F, P	None	No	No	N/A (cannot actually add baby)	No	2
BabyTime	No	No	BF, F, P	S, G	No	No	> 1	Yes	2
BabySparks	Yes	No	None	None	N/A	No	> 1	Yes	2
Baby Tracker.	No	No	BF, F, P	S, G	Yes	No	Singleton	Yes	3
Baby Tracker - My Baby	No	No	BF, F, P	S, G, V	Yes	No	> 1	Yes	2
Baby Care (Baby Tracker and Breast Feeding)	No	No	BF, F, P	S, G	Yes	No	UD	UD	2
Baby +	Yes	No	BF, F, P	S, G, V	Yes	Yes	> 1	Yes	3
Breast Baby: Newborn Tracker	Yes	No	BF, F, P	S	Yes (does not work)	No	> 1	Yes	1
Time for baby - Breastfeeding	No	No	BF, F, P	S, G	Yes	No	> 1	No	2
Baby's Journal	No	No	BF, F, P	S, G	Yes	No	> 1	Yes	1
WebMD Baby	Yes	No	BF, F, P	S, G	Yes	No	> 1	Yes	2
Breastfeeding Newborn tracker	No	No	BF, F, P	S, G	Yes	No	> 1	Yes	2
Babio - Baby Activity Tracker	No	No	BF, F, P	S	Yes	Yes	> 1	Yes	1
Nara Baby Tracker	No	No	BF, F, P	S, G, V	Yes	No	> 1	Yes	1
What To Expect	Yes	Yes	BF, F, P	S, G, V	Yes	No	> 1	Yes	3
PiyoLog - Baby Feed Tracker	No	No	BF, F, P	S, G, V	No	No	> 1	Yes	2

Table 6 (continued)

App name	Breastfeeding info (Y/N)	Prenatal breastfeeding info (Y/N)	Feeding tracker: BF, F, P	Other tracking: S, G, V	Feeding stopwatch	Formula/ bottle icons	Singleton or > 1 baby (Y/N)	Able to add pictures?	Our user rating (1-5)
BabyFeed	No	No	BF, F	S	No	No	UD	Yes (with premium version)	2
Mother's Milk Nursing Log	No	No	None	None	N/A	No	N/A	No	2
Similac Baby Journal	No	No	BF	None	Yes	No	N/A (cannot actually add baby)	No	1
Baby Diary Pumping	Yes	No	BF, F, P	S, G, V	Yes	No	> 1	Yes	1
Nursing Notebook theAsiaparent	No	No	BF, F, P	S, G, V	Yes	No	> 1	Yes	1
Circle by St. Joseph Health	Yes	yes	BF	S, G	Yes	No	Singleton	Yes	1
Awesome Baby Tracker	Yes	No	None	No	N/A	No	> 1	Yes	3
ParentLove: Baby Tracker	No	No	BF, F, P	G, V	Yes	No	> 1	No	2
SuperMama	No	No	BF, F, P	S, G, V	Yes	No	> 1	Yes	2
Eat Sleep: Simple Baby Tracker	No	No	BF, F, P	S, G, V	Yes	No	Singleton	Yes	3
Nod Baby Sleep Coach and Tracker	Yes	UD	None	S	No	UD	> 1	Yes	1
Baby Loggy - newborn care log	Yes	No	BF, F	None	N/A	UD	UD	UD	NR
BabyDiary - The Baby Tracker	No	No	BF, F, P	S, G, V	Yes	No	Singleton	Yes	3
Baby Feeding Log	No	No	BF, F, P	S, G, V	Yes	Yes	> 1 with paid upgrade	Yes	1
Kinedu	Yes	No	BF, F	S	Yes	No	N/A; (cannot actually add baby)	No	1
Pacify	No	UD	None	None	N/A	UD	> 1	Yes	3
Circle by Providence	Yes	No	None	None	N/A	UD	N/A	No	NR
Mamava	Yes	No	None	G, V	Yes	No	> 1	Yes	3
Pregnancy Tracker + Countdown to Baby Due Date	Yes	Yes	None	None	G	No	> 1	Yes	3
BabyCenter	Yes	Yes	None	None	G	No	N/A	Yes	2
Tinyhood	Yes	Yes	None	None	N/A	No	> 1	Yes	2
Baby Connect	No	UD	BF, F, P	S, G, V	Yes	UD	> 1	Yes	NR
Laich ME	Yes	UD	None	None	N/A	UD	N/A	No	NR
Breastfeeding Central	Yes	Yes	None	None	N/A	UD	N/A	No	NR
Littlefeed	No	UD	BF, F, P	None	UD	UD	UD	No	NR
Noa Breastfeeding Timer	No	UD	BF, F	None	Yes	UD	UD	No	NR
Breastfeeding Tracker by bf	No	UD	BF	None	Yes	UD	UD	Yes	NR
Mother's Milk Messaging	No	UD	None	None	N/A	UD	N/A	UD	NR
Baby Care Plus	No	UD	BF, F, P	S, G, V	UD	UD	UD	Yes	NR
Nancy/Mohrbacher Breastfeeding Solutions	No	UD	None	None	N/A	UD	N/A	No	NR
Breastfeeding- Baby Tracker	Yes	UD	BF, F (P paid add on)	(S, G paid add on)	UD	UD	UD	UD	NR

Feeding tracker: BF, breastfeeding; F, formula; P, pumping sessions. Other tracking: S, sleep; G, growth; V, vaccines

UD, undetermined (because app was inaccessible due to cost or phone incompatibility)

NR, not rated

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