



Breastfeeding is Possible: A Systematic Review on the Feasibility and Challenges of Breastfeeding Among Breast Cancer Survivors of Reproductive Age

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ABSTRACT

Background. Breastfeeding is the biologically normative mode of feeding human infants, and reduces the risk of breast cancer for mothers. This systematic review assesses engagement in breastfeeding and the factors associated with breastfeeding among breast cancer survivors.

Methods. An online literature search was performed using the PubMed, Embase, CINAHL, PsychInfo, and Web of Science databases. Inclusion criteria were original research articles written in English, published in peer-reviewed journals from 1 January 1990 to 25 November 2019, and included data on breast cancer survivors who attempted breastfeeding.

Results. Thirteen studies were included in the systematic review. Between 7.7 and 90.9% of women attempted breastfeeding. Breastfeeding among participants varied from a few weeks to approximately 2 years. Common factors leading to breastfeeding were use of the contralateral breast, support from others, lactation counseling and advice from an International Board-Certified Lactation Consultant, being motivated to breastfeed, frequent feedings, and use of galactagogues. Common barriers were medical counseling against breastfeeding, insufficient milk

production, lack of support, refusal of the infant to breastfeed from the treated breast, and being tired from relying on one breast.

Conclusions. Breastfeeding from the unaffected breast is feasible for some breast cancer survivors. Successful breastfeeding may require multilevel support and expert advice.

Breast cancer is one of the leading causes of deaths among women under the age of 35 years.¹ Young women with breast cancer have poorer survival rates than older women, even if they are diagnosed early.² The higher mortality rates among young women with breast cancer can be partially explained by several factors. Young breast cancer patients tend to present with advanced stages of invasive cancer.³ Additional prognostic factors such as the use of oral contraceptives, family history of breast cancer, and shorter periods of breastfeeding may influence risk.^{3–5} Possibly most significantly, postpartum mammary gland involution that may extend for at least 5 years promotes the development of tumors with increased metastatic capability.^{6,7} This may be related to increased lymphangiogenesis,⁸ extracellular matrix deposition,⁹ fibroblast activation¹⁰ and changes in the tissue microenvironment similar to wound healing.¹¹ Thus, it is important to identify and promote health behaviors that can improve the survival rates and, ultimately, the overall quality of life among young breast cancer survivors.

Breastfeeding can improve the survival rates and overall quality of life of breast cancer survivors of reproductive age.^{12,13} Breastfeeding not only provides essential nutrients for an infant's growth and normal development but also confers numerous benefits to the mother.¹⁴ A meta-analysis found that the risk of breast cancer reduces by 4.3% for every 12 months of breastfeeding.¹⁵

Implications for Cancer Survivors

There appears to be a need for interventions that promote feasible breastfeeding among breast cancer survivors who choose to breastfeed. Consultation with a multidisciplinary team may be needed to address prenatal and postpartum challenges related to breastfeeding.

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Although more evidence is needed, it is generally recommended for cancer survivors to wait approximately 1–2 years after treatment to attempt conception.¹⁶ Five to 10 years of endocrine therapy may substantially reduce the chance of conception among breast cancer survivors. Findings from the forthcoming POSITIVE (Pregnancy Outcome and Safety of Interrupting Therapy for Women with Endocrine Responsive Breast Cancer) trial will be useful in providing additional evidence on the likelihood of successful conception and cancer outcomes after temporary interruption of endocrine therapy.¹⁷ This trial will also help provide healthcare professionals the additional information they may need to improve counseling and treatment for breast cancer patients who want to conceive and breastfeed successfully.¹⁷

There is a lack of support and encouragement from healthcare professionals to promote breastfeeding and maternal counseling among young women treated for breast cancer. Obstetricians and oncologists tend to discourage breast cancer survivors from breastfeeding by assuming ‘a priori unfeasibility’.¹³ Consequently, factors including lack of medical support and maternal counseling can influence the decisions and ability to breastfeed among young breast cancer survivors.^{18,19} Unfortunately, breastfeeding is not possible among women who have undergone bilateral mastectomy.

Choosing unilateral surgery and leaving the unaffected breast intact can increase the likelihood of successful breastfeeding among breast cancer patients.²⁰ In cases where patients have undergone breast-conserving therapy (BCT), the treated breast may produce milk, but the volume and quality of breastmilk are significantly reduced due to changes in the breast and nipple.²¹ Breastfeeding from the unaffected breast may be the most promising strategy. Although contralateral breastfeeding is possible and the treated breast is able to produce some milk, many breast cancer survivors experience other significant challenges such as uncertainty about breastfeeding from one side, lack of support from physicians and family members, lack of access to an International Board-Certified Lactation Consultant (IBCLC),¹⁹ and nipple pain and discomfort.¹³

Despite emerging evidence that breastfeeding is feasible and should be encouraged among women who have successfully undergone breast cancer treatment,²¹ there is a lack of information on the number of breast cancer survivors who breastfeed after treatment, and their experiences regarding breastfeeding. The specific research questions in this systematic review are as follows: (1) how prevalent is breastfeeding among breast cancer survivors following breast cancer treatment; and (2) what are the factors associated with breastfeeding among breast cancer

survivors? These findings could inform interventions to encourage and support breastfeeding among breast cancer survivors.

METHODS

Search Strategy

The protocol for this review has been registered on the International Prospective Register for Systematic Reviews (PROSPERO; registration ID: CRD42020163896). This review did not involve human subjects, therefore approval from the Institutional Review Board was not required. We searched for original research papers in the PubMed, Embase, CINAHL, PsychInfo, and Web of Science databases. Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, we systematically searched for studies that examined breastfeeding rates among breast cancer survivors. We worked with a research librarian at our institution to refine the search terms and strategy. In short, our search queries included the following terms, related words, and synonyms: breastfeed OR lactate AND breast cancer survivor. For instance, while searching for studies on PubMed, we included the following search terms: (breastfeed* OR breastfeeding OR lactat* OR breastmilk) AND (breast cancer survivor* OR breast cancer patient*). After relevant studies were identified ($n = 10$), we reviewed their reference lists to search for additional articles.

Inclusion/Exclusion Criteria

We included studies that examined what proportion of breast cancer survivors attempted to breastfeed and/or were able to breastfeed, as well as the factors associated with breastfeeding. The specific inclusion criteria were original research articles published in peer-reviewed journals from 1 January 1990 to 25 November 2019, written in English, and the priority populations included breast cancer survivors who attempted breastfeeding following breast cancer treatment. We included studies published between 1 January 1990 and 25 November 2019. Studies having either a descriptive (e.g. surveys and case studies) or correlational (e.g. case–control studies) research design were considered for inclusion. No experimental designs were found. Studies that considered women who were diagnosed with breast cancer after pregnancy (i.e. pregnancy-associated breast cancers) were excluded since this systematic review focuses on breast cancer survivors who attempted to breastfeed *after* breast cancer treatment. Other exclusion criteria were studies that did not assess breastfeeding after breast cancer treatment, measures assessed in the studies or

the target population were not clear, and articles were reviews, letters to the editor, abstracts only, or dissertations.

Study Selection and Data Extraction

Using Endnote, 2 authors (TB and ZN) conducted an independent screening of all articles retrieved from the PubMed, Embase, CINAHL, PsychInfo, and Web of Science databases. The 2 authors screened articles based on titles, titles and abstracts, and, finally, full-text review of articles. The third author (CH) resolved any disagreements in the selection of studies. To decide on the final exclusion of a study, all 3 authors discussed the article based on the inclusion and exclusion criteria and reached agreement. One author reviewed the reference lists of all studies that met the inclusion criteria in order to identify additional

relevant articles. The study selection and exclusion process are shown in Fig. 1.

To answer the main research questions of this systematic review, the authors developed a data extraction tool to describe the study authors and year of publication, country where the study was conducted, participant characteristics, research design, key findings (number or percentage of women who breastfed, duration of breastfeeding, factors associated with breastfeeding/not breastfeeding), and strengths and limitations of the studies. One author extracted data from all included full-texts (TB), and the remaining 2 authors reviewed the extracted data to ensure that the information documented was accurate. Discrepancies among the authors were resolved through discussion.

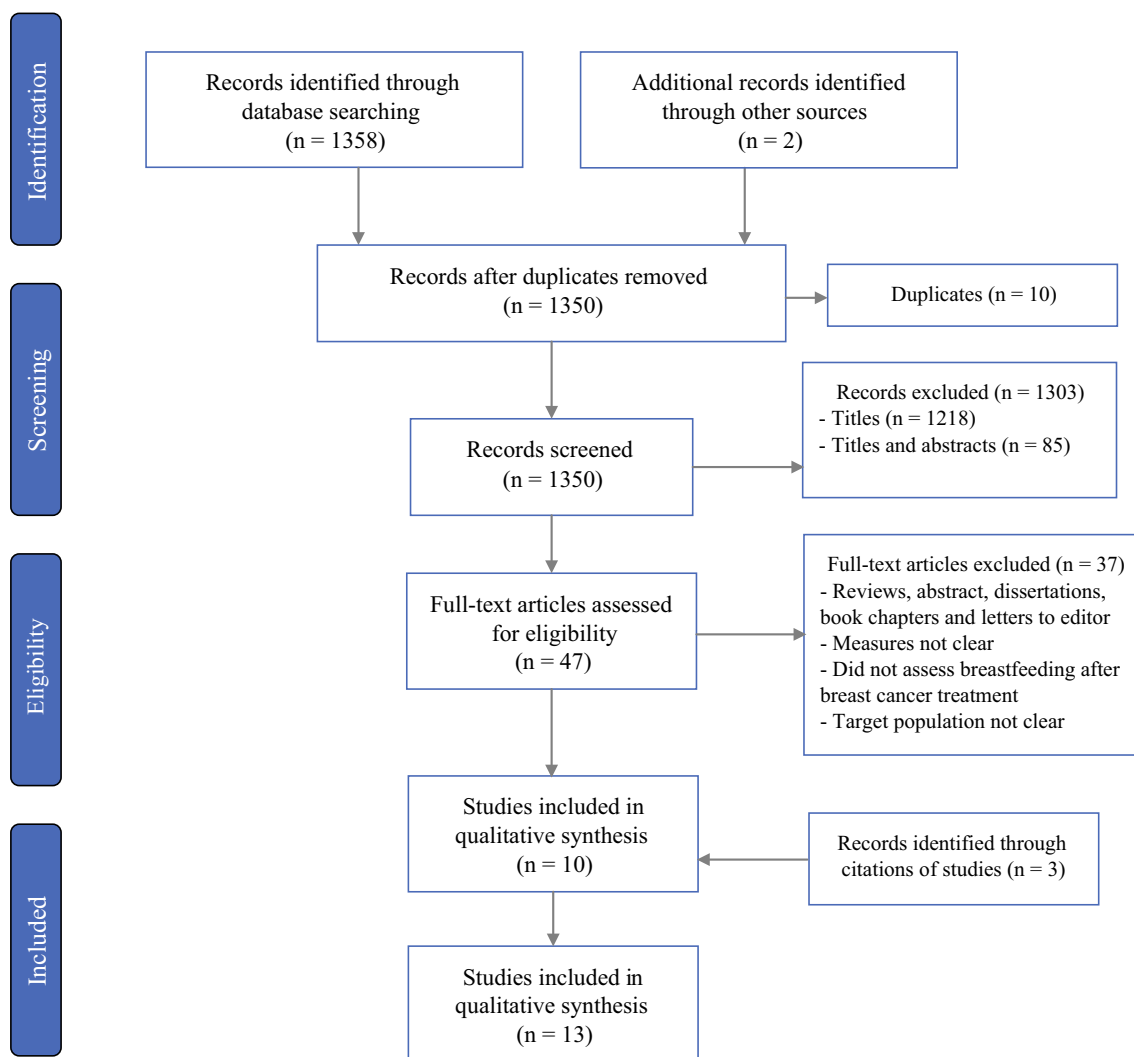


FIG. 1 PRISMA flow chart showing how the screening and selection of studies was carried out. PRISMA Preferred Reporting Items for Systematic Reviews and Meta-Analyses

Quality Assessment and Risk of Bias in Studies

We assessed the quality of studies and risk of bias using the latest version of the Mixed Methods Appraisal Tool (MMAT)²² and guidelines to evaluate qualitative research studies.²³ The quality of quantitative studies was assessed using the following questions/items: was the study informed by a theoretical framework; were measurement variables appropriately described; was the sampling of participants appropriately described; did the authors report a power calculation; were analytical methods used to control confounding reported; were statistical tests appropriately used to answer the main research question(s); were inclusion or exclusion criteria provided; and did the author(s) identify any potential biases? The quality of qualitative studies was assessed using the following questions/items: was the study informed by a theoretical framework; was the qualitative approach appropriately described to answer the research question(s); were the key characteristics of the sample provided; were the data collection methods adequately described; were the findings adequately derived from the data; was there sufficient breadth to the findings elicited from the participant(s); were the findings interpreted within the context of other studies; and did the author(s) outline any potential biases? Two authors (TB and ZN) independently reviewed all the included studies and rated (0 or 1) for each item evaluating the study quality of each study. A score of 0 was given for items that were missing or ambiguous, whereas a score of 1 was assigned for the study meeting that criterion. A kappa statistic was calculated to test interrater reliability.

RESULTS

Study Selection

Based on the initial search of the databases, 1358 articles were retrieved. Two additional articles were identified through Google Scholar. After duplicates were removed, TB and ZN screened 1350 articles. We excluded 1218 articles based on titles only and 85 articles based on titles and abstracts. Forty-seven full-text articles were assessed for eligibility. We excluded 37 full-text articles for the following reasons: studies did not assess breastfeeding after breast cancer treatment, measures assessed in the studies or the target population were not clear, articles were systematic or comprehensive reviews, there were a few letters to the editor and dissertations, and 1 study was an abstract from a symposium. Furthermore, one study was excluded because it was unclear whether participants expressed milk from their lactating breasts to breastfeed their infants. Three articles were retrieved by reviewing the references of

the 10 previously included studies. A final list of 13 articles was obtained (Fig. 1).

Study Characteristics

Six studies were conducted among breast cancer survivors in the US.^{19,24–28} The remaining studies were conducted among populations in Italy,¹³ Israel,²⁹ Australia,³⁰ Korea,²⁰ Greece,³¹ the US, and Canada.³² One study recruited different breast cancer survivors from various countries, namely Belgium, Denmark, Spain, Italy, the US, and Lebanon (Table 1).³³

The research designs and methodologies varied across studies (Table 1). Five studies made use of case studies of individual or small groups of breast cancer survivors;^{26–29,31} 2 studies used surveys to assess breastfeeding post breast cancer treatment;^{13,32} 2 studies utilized mixed methods, including review of medical records and mailed or telephone surveys;^{20,24} and 2 studies used semi-structured, open-ended telephone interviews¹⁹ or implemented a multicenter case–control research design.³³ Connell et al.³⁰ used a longitudinal qualitative design and interviewed participants 3 times over a period of 12–18 months. Only 2 studies described the use of a theoretical framework that informed the development of questions asked to participants.^{19,30} These theoretical frameworks were guided by constructionist epistemology³⁰ and social cognitive theory.¹⁹

Participant Characteristics

Studies in this systematic review recruited women aged between 20 and 40 years, with most women being in their early and mid-30s (Table 1).^{13,19,20,24,29,31,32} Seven studies focused on participants with early-stage type I or II breast cancer.^{13,19,20,24,25,27,28} Most studies ($n = 8$) included participants who underwent BCT and/or received radiation treatment.^{13,19,24,25,28,29,31,32} Four studies reported the use of chemotherapy among participants.^{25,29,31,33} Data on the number of women who underwent lumpectomy or mastectomy were available in 3 studies.^{19,27,30}

Breastfeeding Prevalence and Duration among Breast Cancer Survivors

Breastfeeding initiation and duration varied across studies (Table 1). Even though many breast cancer survivors had successful deliveries, not all of them breastfed their infants.^{13,19,20,24–26,30–33} Between 7.7 and 90.9% of breast cancer survivors who had successful deliveries attempted breastfeeding.^{13,19,20,24,25,29,30,32,33}

Breastfeeding duration varied between a few weeks to more than 2 years.^{13,19,20,24,25,27–33} In the study conducted

TABLE 1 Characteristics, key findings and limitations of the included studies

Authors, year	Country	Participant characteristics	Research design	Key findings	Strengths (+) and limitations (-)
Azim Jr et al., 2010 ⁷	Italy	Women with early invasive breast cancer aged \leq 40 years ($n=20$) Median age at delivery was 36 years Patients treated with BCS and radiotherapy	Telephone-based survey	10 women (50%) attempted breastfeeding 4 women stopped breastfeeding after 1 month due to reduced milk production ($n=2$) and mastitis in the untreated breast ($n=2$) Women who breastfed for a median duration of 12 months received lactation counseling ($n=5$) Reasons for not attempting breastfeeding: personal choice ($n=1$) and medical counseling against breastfeeding ($n=9$) Reason for not attempting breastfeeding from the treated breast were difficulty in latching ($n=2$), reduced milk production ($n=2$), and breast pain ($n=1$)	(+) Detailed information about the breastfeeding pattern (-) Small sample size
Berkovich and LH had 5 children after her		Goodman, 2009 ²⁴ treatment and each infant breastfed for 12–16 months SB died in 2008 and had no children post-treatment	Israel (-) Limited sample (-) Detailed information about breastfeeding choices was not provided	Women (LH and SB) diagnosed with ER + breast cancer ($n=2$) Age of participants was 30 and 27 years at diagnosis, respectively Treated with chemotherapy and radiation	Case study
Connell et al., 2006 ²⁵	Australia	Breast cancer subtype unknown ($n=13$) Median age at diagnosis: 37 years 6 women had lumpectomy and 7 had mastectomy	Longitudinal qualitative design Use of semi-structured in-person/telephone interviews conducted three times over 12–18 months Use of constructionist epistemology	2 women gave birth to infants after diagnosis 1 of these women did not feel comfortable breastfeeding from the treated breast The other (7.7%; 1/13) breastfed for only a few weeks so that her breast could be in a non-lactating state for a mammogram	(-) Duration of breastfeeding was not assessed over time (-) Limited sample
Dow et al., 1994 ¹⁹	United States	Stage I or II breast cancer patients ($n=46$) Caucasian (96%), married (96%), and with some college education (77%) Mean age at diagnosis: 30.4 years Treated with BCS and radiation therapy	A case-matched mixed methods (review of radiation oncology treatment records and a mailed survey) 23 cases and 23 controls	2 women (8.7%) attempted breastfeeding and discontinued due to infants' dissatisfaction with poor milk production The majority of participants (% unknown) were advised not to breastfeed from the irradiated breasts due to the likelihood of mastitis	(+) Compared cases with controls (-) Small sample

TABLE 1 continued

Authors, year	Country	Participant characteristics	Research design	Key findings	Strengths (+) and limitations (-)
Gorman et al., 2009 ¹⁴	United States	Stage I (27%) or II (73%) breast cancer survivors (<i>n</i> =11) 100% White population 5 women aged ≤ 30 years, 4 women aged 31–34 years, and 2 women aged 35–40 years 7 women underwent lumpectomy and 4 women underwent mastectomy	Semi-structured, open-ended telephone interviews Use of the Social Cognitive Theory to inform questions	10 participants (90.9%) initiated breastfeeding Participants breastfed their children for an average of 8 months Most participants supplemented with formula immediately after or between 1 and 4 months after starting breastfeeding Beliefs elicited from participants: cautiously hopeful, exhausting to rely on one breast, motivated despite challenges, support and lack of support, and encouraging to others	(+) Detailed information on perceptions of breast cancer survivors regarding breastfeeding (-) Small sample (-) All participants were White and most were at least college-educated
Higgins and Haffty, 1994 ²⁰	United States	11 stage I (<i>n</i> =7) or stage II (<i>n</i> =3) breast cancer patients who had breast-conserving therapy 7 patients received irradiation 3 patients received chemotherapy	Phone and/or in-person interviews	4 participants experienced lactation from the treated breast, but only one (9.1%) patient breastfed from the treated breast for 4 months Most women (% unknown) were able to breastfeed successfully from the untreated breast Milk production was lower in the treated breast Lactation was likely to be more difficult among women who had an incision near the areola-nipple complex (<i>n</i> =2)	(-) Small sample (-) Sociodemographic information not available
Jerome et al., 1997 ²¹	United States	A married White woman diagnosed with ductal carcinoma (<i>n</i> =1) Age: 24 years Patient had mastectomy	Case study	Lactation occurred but the patient chose to not breastfeed Reasons for not breastfeeding unknown	(-) Reasons for not breastfeeding were not provided
Kim et al., 2017 ²⁶	Korea	Women with invasive breast cancer (<i>n</i> =15) Mean age: 30.4 years 7 patients received BCS and 5 had total mastectomy	Mixed methods Retrospective review of medical records combined with telephone surveys	12 women (80.0%) reported no difficulties in breastfeeding Women who breast-fed used the contralateral breast for breastfeeding Duration of breastfeeding was 1–12 months	(-) Loss to follow-up occurred at the beginning of the study (-) Duration of breastfeeding for each woman was not available
Kontzoglou et al., 2009 ²⁷	Greece	Breast cancer patients (type III invasive ductal carcinoma) and 34 patients (type II ductal invasive carcinoma), respectively (<i>n</i> =2) Age: 28 years Both patients received chemotherapy and radiation treatment	Case study of two patients	The 28-year-old patient breastfed her infant for 3 months The other patient did not breastfeed her infant	(-) Reasons to breastfeed/not breastfeed were not provided
Lambertini et al., 2018 ²⁹	Belgium, Denmark, Spain, Italy, United	ER + (<i>n</i> =194) and ER - (<i>n</i> =139) breast cancer survivors Mean age: 32 years	Multicenter case-control (333 cases matched to 874 controls)	333 patients (13.3%) breastfed their infants 39% did not breastfeed, and breastfeeding status was unknown for 66.0%	(-) Large sample size (-) Retrospective study

Table 1 (continued)

Authors, year	Country	Participant characteristics	Research design	Key findings	Strengths (+) and limitations (-)
	States, Lebanon	Patients treated with mastectomy, BCS, adjuvant chemotherapy, and adjuvant hormonal therapy			(-) Sociodemographic data not available
Michaels and Wanner, 2013 ²²	United States	A Caucasian woman diagnosed with stage 0 ductal carcinoma in situ and noninvasive lobular carcinoma (<i>n</i> = 1) Age: 37 years The patient had a right mastectomy without radiation and chemotherapy	Case study	The woman exclusively breastfed her twins for 3 months and continued breastfeeding for approximately 2 years Advice from an International Board-Certified Lactation Consultant: early skin-to-skin contact, frequent feedings, and pumping after each breastfeeding session Use of a hospital-grade double electric breast pump to improve latching Frequent pumping of the breast Support of family, friends, and nursing students Use of galactagogue to increase milk production	(+) Detailed information about breastfeeding patterns and practices was documented
Tralins, 1995 ²⁸	United States and Canada	Patients with stage I or II breast cancer (<i>n</i> = 53) Mean age for the pregnant cohort was 30.3 years Treated with BCS and radiotherapy	Cross-sectional survey	18 women (34%) experienced lactation Only 13 patients (24.5%) breastfed their infants Reasons for not breastfeeding were insufficient milk production (<i>n</i> = 3), voluntary milk cessation through hormones (<i>n</i> = 1), and infant refused to breastfeed from the treated breast (<i>n</i> = 1)	(-) Duration of breastfeeding not available (-) Other sociodemographic information not available
Varsos and Yahalom, 1991 ²³	United States	A woman with early-stage ductal carcinoma at diagnosis Age: 38 years Treated with radiotherapy	Case study	Colostrum produced from both the untreated and treated breasts after delivery The treated breast produced milk in small amounts The treated breast stopped producing milk after 2 weeks After 2 weeks, the baby breastfed solely from the untreated breast, which had full lactation The woman was still breastfeeding her baby at 5 months when the original article was written	(-) Follow-up regarding breastfeeding was not documented after 5 months

BCS breast-conserving surgery, ER+ estrogen receptor-positive, ER- estrogen receptor-negative

by Kim et al.,²⁰ all women who got pregnant (*n* = 12) were able to breastfeed their infants without any difficulties for an average period of 1–12 months. One of the 2 participants recruited by Connell et al.³⁰ decided to breastfeed for only a few weeks, whereas Gorman et al.¹⁹ reported that

most participants breastfed their infants for an average of 8 months. The highest duration of breastfeeding was observed in 1 study,²⁷ whereby a breast cancer survivor who had undergone a right-sided mastectomy was able to breastfeed her twins for up to more than 2 years.

Findings regarding exclusive breastfeeding were not clear. Only 2 studies explicitly reported exclusive breastfeeding.^{19,27} Most participants exclusively breastfed their infants for between 1–4 months, after which they supplemented with formula.¹⁹ Notably, in the case study by Michaels and Wanner,²⁷ the participant exclusively breastfed her twins for 3 months.

Factors Underlying Breastfeeding Among Breast Cancer Survivors

Self-reported factors that were associated with the initiation and continuation of breastfeeding were use of the contralateral breast;^{20,25,28} support from multiple sources to breastfeed;^{19,27} lactation counseling, including advice from an IBCLC;^{13,27} motivation to breastfeed despite challenges; not feeling ‘stressed’ about breastfeeding; setting an example for other survivors and encouraging others to breastfeed;¹⁹ early skin-to-skin contact; frequent feedings; pumping after breastfeeding; use of an electric breast pump; and use of galactagogues (substances that increase milk supply) (Table 1).²⁷

Reasons for not breastfeeding were unavailable in 6 studies, as observed in Table 1.^{20,25,26,29,31,33} Among women who did not breastfeed, they cited reasons such as personal choice, medical counseling against breastfeeding, insufficient milk production, voluntary milk cessation through hormones, and refusal of the infant to breastfeed from the treated breast.^{13,24,32} Only 3 studies made it clear whether participants attempted to breastfeed but stopped due to reduced milk production, mastitis in the lactating breast,¹³ wanting their affected breast to be in a non-lactating state,³⁰ and infants’ perceived dissatisfaction with milk production.²⁴ Challenges that participants reported while breastfeeding from the treated breast were difficulties in latching, reduced milk production and breast pain,¹³ not being comfortable breastfeeding, and fear of recurrence of breast cancer in the lactating breast.³⁰ Seven studies reported that milk production from the treated breast was low and insufficient to breastfeed.^{13,25,27,28,30,32} Even if colostrum (antibody-rich secretion from mammary glands immediately after birth) was produced from both breasts after delivery, milk production from the treated breast stopped after 2 weeks in 1 case study.²⁸ Moreover, reduced milk production in the treated breast led to discontinuation of breastfeeding among participants due to their infants’ perceived dissatisfaction with limited breastmilk.^{24,28} Participants also reported contralateral breastfeeding to be challenging because they were worried about nursing from 1 side only, felt that it was a major commitment and physically difficult, and they were frustrated with milk supply.¹⁹

Assessment of Quality and Risk of Bias in Studies

A Kappa value of 0.79 was obtained, indicating substantial agreement between the 2 raters.³⁴ Table 2 shows the rating of each item for each study. Only 2 studies made use of a conceptual framework to guide their study,^{19,30} and only 4 studies reported any potential biases or limitations.^{19,20,24,30} These studies used a small convenience sample that is predominantly White and well-educated. Selection bias might have occurred since patients with more favorable prognosis are more likely to get pregnant and breastfeed. There were a few studies that did not provide key characteristics (e.g. stage of breast cancer, sociodemographic information) about participants (Table 2).^{25,26,28,32,33} Findings on the duration of breastfeeding and reasons for breastfeeding were not available in some studies.^{20,26,29–32} For studies using a quantitative descriptive design, no power calculation was reported to determine the sample size.^{13,20,24,32,33} Only 1 study controlled for confounding factors in their statistical analyses.³³ Additionally, inclusion and exclusion criteria were not clear in most studies. A very small sample size was also noted in most studies.

DISCUSSION

To the best of our knowledge, this systematic review is the first to assess the prevalence of breast cancer survivors attempting to breastfeed after diagnosis and treatment, and to summarize the factors associated with breastfeeding after breast cancer. Despite the numerous benefits of breastfeeding for breast cancer survivors,³⁵ few studies appear to have examined the feasibility and factors associated with breastfeeding in this population. In order to improve breastfeeding initiation and duration among breast cancer survivors of reproductive age, it is critical to examine the factors that would enable them to do so. Results from the current study provide important insights into how many women attempted to breastfeed after undergoing treatment for breast cancer and what factors could potentially help them to successfully breastfeed their infants.

The World Health Organization (WHO) recommends that infants should be exclusively breastfed for the first 6 months of life, and breastfeeding should continue for at least 2 years with the introduction of complementary foods.³⁶ Despite having successful pregnancies, not all women (7.7–90.9%) chose to or were able to breastfeed.^{13,19,20,24,25,29,30,32,33} Exclusive breastfeeding among most participants was between 1 and 4 months,¹⁹ indicating rates lower than the level recommended by the WHO.³⁶ Breastfeeding duration lasted between a few weeks to more than 2 years.^{13,19,20,24,25,27–33} Only 1 study reported the

TABLE 2 Assessment of risk of bias and quality of studies included in the systematic review

Authors, year	Was the study informed by a theoretical framework?	Were measurement variables appropriately described?	Was the sampling of participants appropriately described?	Did the author(s) report a power calculation?	Were analytical methods used to control confounding reported?	Were statistical tests appropriately used to answer the main research question(s)?	Were inclusion/exclusion criteria provided?	Did the author(s) address any potential biases?
<i>Studies using quantitative or mixed methods</i>								
Azim Jr. et al., 2010 ⁷	0	0	1	0	0	0	0	0
Dow et al., 1994 ¹⁹	0	1	1	0	0	1	1	1
Kim et al., 2017 ²⁶	0	1	1	0	0	1	0	1
Lambertini et al., 2018 ²⁹	0	1	1	0	1	1	0	1
Tralins, 1995 ²⁸	0	0	1	0	0	0	0	0
<i>Studies using qualitative methods</i>								
Berkovich and Goodman, 2009 ²⁴	0	0	0	1	0	0	1	0
Connell et al., 2006 ²⁵	1	1	1	1	1	1	1	1
Gorman et al., 2009 ¹⁴	1	1	1	1	1	1	1	1
Higgins and Haffty, 1994 ²⁰	0	1	1	1	1	1	1	0
Jerome et al., 1997 ²¹	0	1	1	0	1	1	0	0
Kontzoglou et al., 2009 ²⁷	0	1	1	1	1	1	1	0
Michaels and Wanner, 2013 ²²	0	1	1	1	1	1	1	0
Varsos and Yahalom, 1991 ²³	0	1	1	0	0	0	1	0

case of a survivor who was able to continue breastfeeding her twins for more than 2 years after mastectomy of the right breast.²⁷ Lower rates of exclusive breastfeeding among breast cancer survivors indicate challenges that they might face in terms of getting access to adequate information, support, and oncology counseling³⁷ regarding breastfeeding their infants for an optimal period of time.

There were different factors that were associated with initiation and breastfeeding among breast cancer survivors, among which counseling and support from providers or an IBCLC and support from family members or friends were found to be important.^{19,27} Not surprisingly, breast cancer survivors seemed to be able to practice successful and safe breastfeeding when they received adequate help from a multidisciplinary team of health professionals.^{38,39} As 1 breast cancer survivor reported during their interview, support from a medical team enabled them to identify ways to increase their milk supply and gather information regarding breastfeeding.¹⁹ In particular, physicians associated with the Academy of Breastfeeding Medicine have the knowledge and skills to integrate breastfeeding promotion and support throughout pregnancy and breastfeeding, provide information on medication safety during breastfeeding, and are able to address concerns related to breast surgery and breast cancer treatment.⁴⁰ IBCLCs can also provide various services, including troubleshooting breastfeeding difficulties, breastfeeding prenatal classes, follow-up appointments, and being present near the time of delivery,^{41,42} that can be instrumental to breast cancer patients. However, research regarding support from these healthcare professionals on breastfeeding outcomes has been limited in the general population,⁴³ and even more so among breast cancer survivors.

Challenges that participants faced while breastfeeding were medical counseling against breastfeeding, difficulty in latching, breast pain, not feeling comfortable with it, infants' dissatisfaction with milk supply, trying to rely on one breast only, and lack of support.^{13,19,24,30,32} Insufficient breastmilk production was 1 common challenge cited by participants.^{13,25,28,32} A decrease in lactation in the irradiated breast has been attributed to several reasons: primary location in relation to the nipple, proximity of the incision with the areola-nipple complex, the radiation dose, type of radiation (e.g. electrons, photons), and individual susceptibility to the long-lasting effects of radiation.⁴⁴ Lactation is possible after radiotherapy, and breastmilk production is present in 50% of patients, although in a reduced quantity.⁴⁴ Despite a lack of milk production from the treated breast, successful contralateral (i.e. from the untreated breast) breastfeeding was reported in 3 studies.^{20,25,28} It has been found that breastfeeding from the unaffected breast or contralateral breastfeeding can produce enough milk for not only 1 baby but also for twins.²⁷ Breast cancer patients

can also benefit from hand expression of breastmilk, pumping, and frequent feedings to upregulate milk production in the early postpartum period.^{45,46} In addition, galactagogues, which are substances used to induce, maintain, and increase milk production, can promote lactation.²⁷ The most common galactagogues for human use include domperidone, metoclopramide, chlorpromazine, and sulpiride.⁴⁷ Plants with galactagogue components include fenugreek, fennel, asparagus, goat's rue, anise, and milk thistle.⁴⁷ The use of galactagogues such as fenugreek is questionable given that they increase prolactin levels⁴⁸ and prolactin has been identified as a risk factor for breast cancer development;⁴⁹ however, no studies have assessed the safety of galactagogues among breast cancer survivors.⁵⁰ It is important for mothers to be well-informed about the risks, benefits, dosage, length of treatment, and adverse effects for the mother and infant.

There is limited evidence as to whether breastfeeding affects the risk of breast cancer recurrence in women previously diagnosed with breast cancer. It was found that concerns over breast cancer recurrence and mastitis in the treated breast deterred participants who have undergone breast-conserving surgery and radiation therapy from breastfeeding.^{24,30} Azim Jr and colleagues compared the risk of breast cancer recurrences among breast cancer survivors who breastfed versus those who did not and found that breastfeeding was not detrimental.¹³ Moreover, sustained release of estrogen with some progesterone during pregnancy has been reported to protect against mammary carcinogenesis.^{51,52} These aforementioned concerns can be addressed by a multidisciplinary oncology team that includes breastfeeding medicine physicians and lactation consultants.

Implications for Research and Practice

Breast cancer survivors should be encouraged by breast surgeons and other healthcare professionals to breastfeed their infants. In mastectomy cases, breastmilk production is likely to be limited or absent. Since there is limited information about the safety of breastfeeding from a treated breast, contralateral breastfeeding seems to be the most effective approach. Chemotherapy during breast cancer treatment may reduce breastmilk volume when patients attempt lactation. It should also be noted that breastfeeding is not advised while receiving endocrine therapy.¹⁷

Women who choose to breastfeed should be provided with assistance and skills to maximize milk output by frequent breastfeeding, followed by pumping with electric devices as needed.⁵³ Frequent appointments with a multidisciplinary team, including physicians specialized in breastfeeding medicine, pediatricians, nurse practitioners, and IBCLCs, could be useful in increasing women's

motivation to breastfeed and in addressing challenges they face while they attempt to breastfeed their infants. Given that optimum nutrition is essential in promoting lactation, special attention should be given to the caloric needs of mothers and their micronutrient requirements, such as enough magnesium, vitamin B6, folate, calcium, and zinc.^{54,55} Once lactogenesis has begun among women, safe dosages of medicines, herbs, and other galactagogues may be useful in stimulating milk production if milk supply is low. However, careful decision making should be undertaken when considering galactagogues since limited data on their safety are available.

Programs to improve awareness of health professionals who work in the area of breast cancer should be promoted so they can provide adequate information and support to women during the prenatal and postpartum periods. Improving breastfeeding education during medical training, particularly among obstetricians/gynecologists, pediatricians, family practice physicians, oncologists, and others is important. There is a need for support services and not-for-profit organizations working with breast cancer patients and survivors to raise awareness of reproductive and breastfeeding issues that young women face. These services might benefit from including couples, family members, and friends to provide a network of support to women.

Based on the findings of this systematic review and existing gaps in the current literature, it would be worthwhile to examine the different determinants that influence women's decisions to breastfeed post breast cancer treatment through the lens of a psychosocial theoretical framework.⁵⁷ For example, a multilevel framework could focus on 3 levels of factors that influence breastfeeding—individual, interpersonal, and societal. Individual-level factors include determinants such as beliefs of the mother towards breastfeeding (e.g. intention/motivation to breastfeed), skills and knowledge to breastfeed her child adequately, and mother–infant interaction or bonding. These determinants are often associated with sociodemographic variables such as education level.^{56,57} Societal or group-level factors include characteristics of environments that influence women's decisions to breastfeed. For example, 1 of the key findings of the current study shows that women strongly need the support and encouragement of a multidisciplinary medical team to help them navigate the challenges of breastfeeding after surviving breast cancer.^{13,19,27} Additionally, the support of a partner or other family members or friends is essential in improving motivation to breastfeed.

Other factors impacting breastfeeding include legislation and insurance policies. It was found that the 2012 Affordable Care Act (ACA) policy was associated with an increase of 10% in breastfeeding duration and improved

the duration of exclusive breastfeeding by 21%.⁵⁸ However, the ACA requirements for coverage of breastfeeding support, supplies, and counseling are not comprehensive, leading to variation in insurance policies.⁵⁹ For instance, breastfeeding-related items and services may not be available in general to Medicaid recipients.⁵⁹ Furthermore, populations such as hourly workers are more likely to face barriers to breastfeeding compared with salaried workers because they have less control of their schedules and may face pay reductions if they take time to breastfeed at work.⁶⁰ These upstream factors can positively or negatively impact individual-level factors such as attitudes toward breastfeeding. For example, if breastfeeding is not normalized and strongly encouraged among women who have undergone breast cancer treatment, breast cancer survivors are not likely to initiate and continue breastfeeding their infants. Similarly, a woman might start breastfeeding in the hospital, but continuation of breastfeeding at home is likely to be highly dependent on having access to the skills and knowledge of an IBCLC and support of family members and friends.²⁷

The findings of this systematic review suggest that more research is needed on how to provide prenatal and postpartum support to women who wish to breastfeed after breast cancer treatment. From a research perspective, it is essential to assess the factors that would influence oncology providers and other healthcare professionals to better support the breastfeeding needs of breast cancer survivors of reproductive age. More research is needed on how to better address the fear and anxiety that women face while breastfeeding after breast cancer. Studies that include a large and diverse sample of breast cancer survivors who wish to breastfeed are needed. There is a need to design and evaluate interventions that examine the facilitators and barriers to initiation and continuation of breastfeeding, as well as milk supply among breast cancer survivors. Given the lack of research on the use of galactagogues for improving mothers' breastmilk supply,⁵⁰ more studies that evaluate the dosage, types, and frequency of agents in stimulating breastmilk production are warranted. Future research could also help to determine which of these individual, interpersonal, and societal factors are most important in increasing breastfeeding success among breast cancer survivors.

CONCLUSIONS

Breastfeeding is feasible among some breast cancer survivors of reproductive age; however, breastfeeding in this population appears suboptimal, with significant room for improvement. Because the vast majority of women need to rely on the untreated breast for successful milk

production, particular attention should be given to this issue during prenatal counseling and postpartum care. Breast cancer survivors face considerable challenges in breastfeeding their infants and are in need of significant support compared to the general population. Successful breastfeeding among women, treated for breast cancer, requires support at multiple levels and expert advice from healthcare professionals, including IBCLCs. There is a need for interventions that promote safe and feasible breastfeeding among breast cancer survivors who want to breastfeed their infants, given that breastfeeding contributes to improving the overall health of women and that of their infants.

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REFERENCES

- Kothari AS, Fentiman IS. Breast cancer in young women. *Int J Clin Pract*. 2002;56(3):184–7.
- Fredholm H, Eaker S, Frisell J, Holmberg L, Fredriksson I, Lindman H. Breast cancer in young women: poor survival despite intensive treatment. *PLoS ONE*. 2009;4(11):e7695.
- Axelrod D, Smith J, Kornreich D, et al. Breast cancer in young women. *J Am Coll Surg*. 2008;206(6):1193–203.
- Dolle JM, Daling JR, White E, et al. Risk factors for triple-negative breast cancer in women under the age of 45 years. *Cancer Epidemiol Biomark Prev*. 2009;18(4):1157–66.
- Ghiasvand R, Maram ES, Tahmasebi S, Tabatabaee SHR. Risk factors for breast cancer among young women in southern Iran. *Int J Cancer*. 2011;129(6):1443–9.
- Fornetti J, Martinson HA, Betts CB, et al. Mammary gland involution as an immunotherapeutic target for postpartum breast cancer. *J Mammary Gland Biol Neoplasia*. 2014;19(2):213–28.
- Goddard ET, Bassale S, Schedin T, et al. Association between postpartum breast cancer diagnosis and metastasis and the clinical features underlying risk. *JAMA Netw Open*. 2019;2(1):e186997.
- Fornetti J, Jindal S, Middleton KA, Borges VF, Schedin P. Physiological COX-2 expression in breast epithelium associates with COX-2 levels in ductal carcinoma in situ and invasive breast cancer in young women. *Am J Pathol*. 2014;184(4):1219–9.
- Goddard ET, Hill RC, Barrett A, et al. Quantitative extracellular matrix proteomics to study mammary and liver tissue microenvironments. *Int J Biochem Cell Biol*. 2016;81:223–32.
- Guo Q, Minnier J, Burchard J, Chiotti K, Spellman P, Schedin P. Physiologically activated mammary fibroblasts promote postpartum mammary cancer. *JCI Insight*. 2017;2(6):e89206.
- O'Brien J, Lyons T, Monks J, et al. Alternatively activated macrophages and collagen remodeling characterize the postpartum involuting mammary gland across species. *Am J Pathol*. 2010;176(3):1241–55.
- de Bree E, Makrigiannakis A, Askoxylakis J, Melissas J, Tsiptsis DD. Pregnancy after breast cancer. A comprehensive review. *J Surg Oncol*. 2010;101(6):534–42.
- Azim HA Jr, Bellettini G, Liptrott SJ, et al. Breastfeeding in breast cancer survivors: Pattern, behaviour and effect on breast cancer outcome. *Breast*. 2010;19(6):527–31.
- Prell C, Koletzko B. Breastfeeding and Complementary Feeding. *Dtsch Arztebl Int*. 2016;113(25):435–44.
- Collaborative Group on Hormonal Factors in Breast Cancer. Alcohol, tobacco and breast cancer—collaborative reanalysis of individual data from 53 epidemiological studies, including 58 515 women with breast cancer and 95 067 women without the disease. *Br J Cancer*. 2002;87(11):1234–45.
- Hartnett KP, Mertens AC, Kramer MR, et al. Pregnancy after cancer: does timing of conception affect infant health? *Cancer*. 2018;124(22):4401–7.
- Pagani O, Ruggeri M, Manunta S, et al. Pregnancy after breast cancer: are young patients willing to participate in clinical studies? *Breast*. 2015;24(3):201–7.
- Azim HA, Bellettini G, Gelber S, Peccatori FA. Breast-feeding after breast cancer: if you wish, madam. *Breast Cancer Res Treat*. 2009;114(1):7–12.
- Gorman JR, Usita PM, Madlensky L, Pierce JP. A qualitative investigation of breast cancer survivors' experiences with breastfeeding. *J Cancer Surviv*. 2009;3(3):181–91.
- Kim I, Ryu JM, Paik H-J, et al. Fertility rates in young Korean breast cancer patients treated with gonadotropin-releasing hormone and chemotherapy. *J Breast Cancer*. 2017;20(1):91–7.
- Johnson HM, Mitchell KB. Breastfeeding and breast cancer: managing lactation in survivors and women with a new diagnosis. *Ann Surg Oncol*. 2019;26(10):3032–9.
- Hong QN, Gonzalez-Reyes A, Pluye P. Improving the usefulness of a tool for appraising the quality of qualitative, quantitative and mixed methods studies, the Mixed Methods Appraisal Tool (MMAT). *J Eval Clin Pract*. 2018;24(3):459–67.
- Long AF, Godfrey M. An evaluation tool to assess the quality of qualitative research studies. *Int J Soc Res Methodol*. 2004;7(2):181–96.
- Dow KH, Harris JR, Roy C. Pregnancy after breast-conserving surgery and radiation therapy for breast cancer. *J Natl Cancer Inst Monogr*. 1994(16):131–7.
- Higgins S, Haffty BG. Pregnancy and lactation after breast-conserving therapy for early stage breast cancer. *Cancer*. 1994;73(8):2175–80.
- Jerome KR, Kirk AD, Pecher G, Ferguson WW, Finn OJ. A survivor of breast cancer with immunity to MUC-1 mucin, and lactational mastitis. *Cancer Immunol Immunother*. 1997;43(6):355–60.
- Michaels AM, Wanner H. Breastfeeding twins after mastectomy. *J Hum Lact*. 2012;29(1):20–2.
- Varsos G, Yahalom J. Lactation following conservation surgery and radiotherapy for breast cancer. *J Surg Oncol*. 1991;46(2):141–4.
- Bercovich D, Goodman G. Pregnancy and lactation after breast cancer elevate plasma prolactin, do not shorten and may prolong survival. *Med Hypotheses*. 2009;73(6):942–7.
- Connell S, Patterson C, Newman B. A qualitative analysis of reproductive issues raised by young Australian women with breast cancer. *Health Care Women Int*. 2006;27(1):94–110.
- Kontzoglou K, Stamatakos M, Tsaknaki S, Goga H, Kostakis A, Safioleas M. Successful pregnancy after breast cancer therapy: dream or reality? *Int Semin Surg Oncol*. 2009;6(1):7.
- Tralins AH. Lactation after conservative breast surgery combined with radiation therapy. *Am J Clin Oncol*. 1995;18(1):40–3.

33. Lambertini M, Kroman N, Ameye L, et al. Long-term safety of pregnancy following breast cancer according to estrogen receptor status. *J Natl Cancer Inst.* 2018;110(4):426–9.
34. McHugh ML. Interrater reliability: the kappa statistic. *Biochem Med (Zagreb).* 2012;22(3):276–82.
35. Binns C, Lee M, Low WY. The long-term public health benefits of breastfeeding. *Asia Pac J Public Health.* 2016;28(1):7–14.
36. World Health Organization. Global strategy for infant and young child feeding. 2003. <https://apps.who.int/iris/bitstream/handle/10665/42590/9241562218.pdf?sequence=1>. Accessed 29 Jan 2020.
37. Karaöz B, Aksu H, Küçük M. A qualitative study of the information needs of premenopausal women with breast cancer in terms of contraception, sexuality, early menopause, and fertility. *Int J Gynaecol Obstet.* 2010;109(2):118–20.
38. Pagani O, Azim H Jr. Pregnancy after breast cancer: myths and facts. *Breast Care.* 2012;7(3):210–4.
39. Raphael J, Trudeau ME, Chan K. Outcome of patients with pregnancy during or after breast cancer: a review of the recent literature. *Curr Oncol.* 2015;22(S1):S8–18.
40. Rosen-Carole C, Hartman S, Academy of Breastfeeding Medicine. ABM clinical protocol #19: Breastfeeding promotion in the prenatal setting, revision 2015. *Breastfeed Med.* 2015;10(10):451–7.
41. Thurman SE, Allen PJ. Integrating lactation consultants into primary health care services: are lactation consultants affecting breastfeeding success? *Pediatr Nurs.* 2008;34(5):419–25.
42. Castrucci BC, Hoover KL, Lim S, Maus KC. Availability of lactation counseling services influences breastfeeding among infants admitted to neonatal intensive care units. *Am J Health Promot.* 2007;21(5):410–5.
43. Patel S, Patel S. The effectiveness of lactation consultants and lactation counselors on breastfeeding outcomes. *J Hum Lact.* 2015;32(3):530–41.
44. Leal SC, Stuart SR, de Andrade Carvalho H. Breast irradiation and lactation: a review. *Expert Rev Anticancer Ther.* 2013;13(2):159–64.
45. Chapman T, Pincombe J, Harris M. Antenatal breast expression: a critical review of the literature. *Midwifery.* 2013;29(3):203–10.
46. Barco I, del Carmen Vidal M, García A, Giménez N. Feasibility of unilateral breastfeeding. *Breastfeed Med.* 2015;10(4):228.
47. Penagos Tabares F, Bedoya Jaramillo JV, Ruiz-Cortés ZT. Pharmacological overview of galactogogues. *Vet Med Int.* 2014;2014:602894.
48. Abdou RM, Fathey M. Evaluation of early postpartum fenugreek supplementation on expressed breast milk volume and prolactin levels variation. *Gaz Egypt Paediatr Assoc.* 2018;66(3):57–60.
49. Tworoger SS, Eliassen AH, Zhang X, et al. A 20-year prospective study of plasma prolactin as a risk marker of breast cancer development. *Cancer Res.* 2013;73(15):4810–9.
50. Zuppa AA, Sindico P, Orchi C, et al. Safety and efficacy of galactogogues: Substances that induce, maintain and increase breast milk production. *J Pharm Pharm Sci.* 2010;13(2):162–174.
51. Guzman RC, Yang J, Rajkumar L, Thordarson G, Chen X, Nandi S. Hormonal prevention of breast cancer: mimicking the protective effect of pregnancy. *Proc Natl Acad Sci USA.* 1999;96(5):2520–5.
52. Jordan VC. The 38th David A. Karnofsky lecture: the paradoxical actions of estrogen in breast cancer—survival or death? *J Clin Oncol.* 2008;26(18):3073–82.
53. Camune B, Gabzdyl E. Breast-feeding after breast cancer in childbearing women. *J Perinat Neonatal Nurs.* 2007;21(3):225–33.
54. Cervera P, Ngo J. Dietary guidelines for the breast-feeding woman. *Public Health Nutr.* 2001;4(6A):1357–62.
55. Kominarek MA, Rajan P. Nutrition recommendations in pregnancy and lactation. *Med Clin North Am.* 2016;100(6):1199–215.
56. Colodro-Conde L, Sánchez-Romera JF, Tornero-Gómez MJ, Pérez-Riquelme F, Polo-Tomás M, Ordoñana JR. Relationship between level of education and breastfeeding duration depends on social context: breastfeeding trends over a 40-year period in Spain. *J Hum Lact.* 2011;27(3):272–8.
57. Hector D, King L, Webb K, Heywood P. Factors affecting breastfeeding practices. Applying a conceptual framework. *NSW Public Health Bull.* 2005;16(4):52–5.
58. Gurley-Calvez T, Bullinger L, Kapinos KA. Effect of the Affordable Care Act on breastfeeding outcomes. *Am J Public Health.* 2018;108(2):277–83.
59. Hawkins SS, Dow-Fleisner S, Noble A. Breastfeeding and the Affordable Care Act. *Pediatr Clin North Am.* 2015;62(5):1071–91.
60. McGuire S. US Department of Health and Human Services. The Surgeon General's call to action to support breastfeeding. US Department of Health and Human Services, Office of the Surgeon General. *Adv Nutr.* 2011;2(6):523–4.

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