How do breastfeeding workplace interventions work?: a realist review

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Abstract

Background: Women are representing an increasing share of the labor force, thus, raising the need to accommodate breastfeeding working mothers at the workplace. While there is an emerging body of evidence supporting the positive influence of workplace lactation programs on breastfeeding outcomes, there is a lack of literature on the mechanisms underlying those interventions. Aims of this realist review were three-fold: to uncover underlying mechanisms, determine who benefits the most from such interventions and important contextual factors influencing uptake.

Methods: Purposive bibliographic searches on Medline, Web of Science Core Collection, CINAHL, Global Health, LILACS, Global Index Medicus, Business Source Complete, Proquest Dissertations and Theses and Open Access Theses and Dissertations were conducted to identify relevant publications. Included publications (qualitative and quantitative) described interventions aiming to improve the breastfeeding behavior of working mothers, that were initiated by the employer, reported on breastfeeding outcomes and had a clearly defined workplace. Publications only focusing on maternity leave or that were not published in English, Spanish, Portuguese or German were excluded. A realist approach was followed to identify how workplace interventions work, who benefits the most and the important contextual factors.

Results: The bibliographic search yielded a total of 4985 possible publications of which 37 publications were included in the realist analysis. Effective workplace breastfeeding interventions activate three mechanisms: 1) awareness of the intervention, 2) changes in workplace culture, manager/supervisor support, co-worker support and physical environments, and 3) provision of time. Contextual factors such as the distance between the workplace and the infant and the type of workplace may influence the degree of activation of the underlying mechanisms for programs to positively impact breastfeeding outcomes.

Conclusions: In order to be effective, workplace breastfeeding interventions need to: raise awareness of the intervention(s) available among working mothers as well as their work environment, change the workplace culture, foster manager/supervisor support and co-workers support, provide enough time and adequate space and facilities for women to breastfeed or express breastmilk during the workday.

Keywords: Breastfeeding, Breastfeeding support, Lactation support, Work, Worksite, Workplace, Lactation program, Policy
Background

In the last decades, the number of women entering the labor force has steadily increased and women are representing a larger share of the labor market than ever before [1]. Globally, women’s labor force participation rate is 48.5%, which demonstrates their growing and significant contribution to their various national economies [2]. Because of women’s growing presence in the labor market, there is an increasing number of employers seeking to accommodate the needs of working women who choose to have children and want to breastfeed. Indeed, employers already recognizing the importance of breastfeeding, have offered various levels of lactation support especially for women working in the formal but not the informal sector [3, 4].

It is well established that breastfeeding is associated with numerous short- and long-term health benefits for the breastfeeding mother and the breastfed child. As such, breastfed children have lower risk for morbidity and mortality from infectious diseases, increased intelligence scores, and a reduction in risk for overweight and perhaps diabetes in later life [5–7]. For mothers, breastfeeding is associated with lower risk for breast cancer, ovarian cancer and type 2 diabetes [8].

Despite the various benefits of breastfeeding and the WHO/UNICEF recommendation for exclusive breastfeeding for 6 months, globally only about 44% of infants < 6 months of age were exclusively breastfed in 2019 [9]. This is still below the goal of at least 50% by 2025 defined in the Global Nutrition Targets 2025 by UNICEF and WHO [10]. Maternal employment is often cited as a major barrier to breastfeeding [11] and returning to work is associated with early cessation of breastfeeding [12, 13].

Previous research has shown a positive association between workplace lactation support and interventions with higher breastfeeding rates and duration of breastfeeding [14]. Relatively low-cost interventions such as lactation rooms and nursing breaks may reduce absenteeism and improve workplace performance, commitment and retention, while also improving breastfeeding outcomes [11, 15]. Also, mothers receiving other types of workplace support such as provision of electric breast pumps, access to lactation professionals, and refrigerators for storing their breastmilk in the workplace were more likely to initiate and continue breastfeeding after returning to work [14, 16]. Availability of employer-sponsored childcare and flexible schedules can also increase an employee’s likelihood of success with breastfeeding [17]. Therefore, more and more countries and organizations are introducing measures to support working mothers in reaching their breastfeeding goals [18], thus, enabling mothers to better combine their work requirements and their infant feeding goals.

While there is an emerging body of evidence supporting the positive influence of workplace lactation programs on breastfeeding outcomes [14–16, 19], there is a lack of literature on the mechanisms underlying those interventions. An understanding of these mechanisms is crucial in learning how to operationalize, implement and disseminate robust and effective lactation programs. Systematic reviews focus on the outcome and the level of outcome, thus on statistical inferences, but do not investigate the underlying mechanisms or context of the intervention leading to those outcomes. However, in order to find how interventions work in different contexts, statistical inferences are insufficient. Disentangling the underlying mechanisms linking intervention, context and outcome are needed to support the policymaking and implementation processes under ‘real world’ conditions. Thus, in addition to probability considerations, plausibility and adequacy considerations [20] need to be taken into account in order to understand how workplace-based breastfeeding interventions actually work.

Given the need for an approach that accounts for context, the objective of this study was to follow a realist approach to better understand how worksite related breastfeeding programs work across different contexts.

We followed the realist review approach as it does not focus on making statements about the strength of quantitative vs. qualitative study designs but rather it integrates and values the different perspectives offered by them and enable the researcher to unravel and understand underlying pathways. Furthermore, workplace breastfeeding interventions meet the seven criteria of complex service interventions that can best be examined through the lens of a realist review [21] (Table 1).

In order to inform policy makers and employers about workplace breastfeeding interventions, the specific questions we aimed to answer though this realist review were: 1) How do breastfeeding interventions at the workplace work?, 2) Who benefits the most from such interventions across different contexts?, and 3) What are important contextual factors which determine whether different mechanisms produce their intended breastfeeding outcomes?

Methods

A protocol was written and made publicly available a priori at https://osf.io/phndm/. Due to time limitations, grey literature searches as well as citation chaining as described in the protocol were not conducted.

Search methods and criteria for identification of studies

The search of the bibliographic databases was conducted by a medical research librarian. Controlled vocabulary and keywords for the two concepts “breastfeeding” and “workplace” were used for the search of the bibliographic databases in order to achieve high specificity (Table 2). In
Table 1 The 7 Criteria of Complex Service Interventions and Their Evaluation Through Realist Reviews (after [21])

| Criteria of complex service intervention and their evaluation through realist reviews | Application to workplace breastfeeding programs |
|-------------------------------------------------------------------------------------|-------------------------------------------------|
| 1) Public health interventions hypothesize that after implementing an intervention, the condition will be improved. The review needs to closely follow those underlying theories. | Workplace breastfeeding programs are expected to improve breastfeeding rates among participating working mothers. |
| 2) Public health interventions only accomplish their goals by active input from individuals. It is therefore essential to not only rely on controlled study designs but to also review the actions of involved stakeholders to be able to explain the success or failure of the intervention. | In order to have a successful workplace breastfeeding intervention, active input from several individuals is needed e.g. communicate the availability of a breastfeeding/lactation room, active support from co-worker to take over responsibility while the breastfeeding women is on her pumping break, etc. |
| 3) Public health interventions involve a long and complex pathway which includes the operational changes needed to implement the intervention and the uptake and adherence to the program by the participants. Thus, the review needs to consider the entire implementation chain, determine the needed intermediate outputs for a successful final outcome and define processes and blockage points by including a variety of publication types. | Within the implementation chain of a workplace lactation program, different stakeholders influence each other. Depending on their power, the workplace breastfeeding program differs e.g. workplace lactation programs might be more extensive if employee have strong representatives compared to situations in which the employers strictly follow governmental regulations. |
| 4) Public health interventions are non-linear. The review therefore needs to determine and account for the different influences of the different parties by not only including controlled trials. | The wish for privacy in a lactation room in a woman dominated environment may be different then in a male dominated work environment. |
| 5) Public health interventions are embedded in multiple social systems. Such differences are best uncovered by considering finding from qualitative study designs. | A workplace lactation room can range from simply referring to an empty room vs. a fully equipped lactation room with an accompanying policy regulating breaktime and flexible working hours. |
| 6) Public health interventions differ depending on the context and the understanding of the implementing stakeholder. The review needs to help to understand what similar terms mean to different stakeholders by disentangling underlying implementation mechanisms and contexts behind interventions labelled the same way but in reality being different from each other. | By successfully implementing a workplace lactation policy, the overall work-based environment may change and as a consequence, the policy itself strengthens. |
| 7) Public health interventions are open systems with feedback loops. Hence changes in overall environment as a result of interventions need to be considered across different contexts. | |

Table 2 Overview of Bibliographic Databases and Platforms Used in the Search Process. Realist Review on “How Do Breastfeeding Workplace Interventions Work?”

- Medline (Ovid)
- Web of Science Core Collection, as licensed at Yale University:
  - Science Citation Index Expanded (SCI-EXPANDED) --1900-present
  - Social Sciences Citation Index (SSCI) --1900-present
  - Arts & Humanities Citation Index (A&HCI) --1975-present
  - Conference Proceedings Citation Index- Science (CPCI-S) --1991-present
  - Conference Proceedings Citation Index- Social Science & Humanities (CPCI-SSH) --1991-present
  - Book Citation Index-- Science (BKCI-S) --2005-present
  - Book Citation Index-- Social Sciences & Humanities (BKCI-SSH) --2005-present
  - Emerging Sources Citation Index (ESCI) --2015-present
- CINAHL (Ebsco)
- Global Health (Ovid)
- LILACS
- Global Index Medicus
- Business Source Complete (Ebsco)
- Proquest Dissertations and Theses
- Open Access Theses and Dissertations

In order to include, the publications must have described interventions that aimed to or could be expected to improve the breastfeeding behavior of working mothers and that were initiated by the employer, its representative, an employer-like persona or the work supervisor of the parent(s). Furthermore, the study must have reported on breastfeeding outcomes (quantitative or qualitative) and the workplace must have been clearly defined (either real or virtual space). Any data that described breastfeeding behavior were considered as breastfeeding outcomes. Therefore, studies reporting on databases without subject indexing, we achieved high specificity by searching for the concepts of breastfeeding and workplace in titles and author-provided keywords. The Medline search is provided in Table 3; the remaining searches are provided in Additional file 1.
quantitative breastfeeding outcomes (e.g. exclusive breastfeeding rate, exclusive breastfeeding duration, breastfeeding cessation, duration of any breastfeeding) as well as on qualitative breastfeeding outcomes were included. No date limit for publications nor limitation on types of data collected in the study (qualitative vs. quantitative data) were applied as inclusion or exclusion criteria.

Publications that only focused on maternity leave and that were not published in English, Spanish, Portuguese or German were excluded. Publications only focusing on maternity leave interventions were excluded because the review’s focus is workplace breastfeeding interventions that can be fully influenced by the employer. Maternity leave interventions are often regulated, at least to some extent by governments, and are thus, not under the sole control of the employer. Publications that were published in languages other than English, Spanish, Portuguese or German are listed in a separate supplementary table (Additional file 2). Literature reviews were excluded from the analysis.

The inclusion criteria as well as the maternity leave exclusion criteria were applied to the title-abstract screening stage. Articles initially selected for full-text screening were screened in detail for all inclusion and exclusion criteria. Exclusions at the full-text screening stage were grouped into following reasons: 1) intervention was not initiated by the employer, 2) breastfeeding outcomes not reported, 3) article focused on maternity leave, 4) article not published in English, Spanish, Portuguese or German, and 5) other reasons. All screening rounds were conducted by two reviewers following a consensus approach (KL and VT). Discrepancies were resolved through discussion and consultation with a third reviewer (RPE).

Non-peer-reviewed documents (e.g., conference papers, press releases, etc.) were not included. When such documents were retrieved in the database searches, the document’s authors were contacted for more information when deemed necessary. Dissertations were handled as peer-reviewed articles and authors were not contacted.

Goal of the data extraction was to find context-mechanism-outcome (CMO) patterns that can potentially explain the relationship between the intervention and the outcome by understanding the underlying mechanism in the context in which the intervention takes place. Focusing the data extraction on contexts, mechanisms and outcomes is important to identify reasons behind program successes or failures instead of just identifying successful and unsuccessful interventions [21]. Data extraction was conducted by the two reviewers. The data points extracted from peer-reviewed articles were: year of publication, type of study/publication, country, implementation (type, components/activities and approach), context (full-/part-time employment, type of work position, length of maternity leave, etc.), sample size, implementation period, intervention population and implementation outcomes (acceptability, adaptation, appropriateness, cost, feasibility, fidelity, penetration and sustainability). Additionally, breastfeeding outcomes were extracted to better understand the influence of the intervention on breastfeeding outcomes.

For the development of a CMO framework, we defined the intervention types, intervention category, context categories as well as the breastfeeding outcome for each included study. The CMO framework and findings were summarized and discussed in a narrative synthesis.

Results

Description of articles found through bibliographic search
The bibliographic database search yielded a total of 4879 possible documents. After removing a total of 1522 duplicates, 3357 citations were screened at the title-abstract phase in Covidence. From these 3357 citations, 156 were eligible for full-text screening. Separately, the
search on Open Access Theses and Dissertations (OATD) resulted in a total of 106 possible documents. Because of technical issues with the exportation of search results, the 106 documents from OATD were handled outside of Covidence during the title-abstract screening, thus, only one reviewer screened the OATD search results. A total of 10 OATD documents were found to be eligible for the full text screening. After removing 6 documents that had already been screened in Covidence as a result of the other searches, 4 OATD documents were imported into Covidence for the full-text screening. This led to a total of 160 articles that were eligible for the full-text screening which was conducted by two reviewers. At the full-text screening phase a total of 123 articles were excluded, leaving 37 articles for analysis. Articles were excluded for the following reasons: intervention was not initiated by the employer (32 articles), no report of breastfeeding outcomes (49 articles), not published in English, Spanish, Portuguese or German (4 articles) or for other reasons (38 articles). Subcategories under “other reasons” included articles which could not be delivered via interlibrary loan (10 articles), literature reviews (7 articles) and duplications discovered during full text screening (2 articles). Only one reason for exclusion could be recorded in Covidence. An overview of the screening process is depicted in Fig. 1.

The 37 articles that were included in the realist analysis came from 11 countries. The majority of publications were from studies conducted in the United States of America (19 articles [22–40]). The other publications came from studies in Taiwan (5 articles [41–45]), Brazil (4 articles [46–49]), Thailand (2 articles [50, 51]), Australia [52], China [53], Ethiopia [54], Indonesia [55], Mexico [56], Spain [57] and Turkey [58] (each 1 article). The 37 articles resulted from 33 single studies published over a period of 35 years; from 1985 to 2020. An overview of the included studies is given in Tables 4, 5, 6, 7, 8 and 9.

The intervention sample in all but one study, was conformed by employed women. Sahip and Turan [58] described the effects of a workplace health program for expectant fathers in Turkey. The intervention was delivered by specially trained workplace physicians and consisted of six 3–4 h sections: 1) health during pregnancy, 2a) pregnancy nutrition, 2b) birth, 3) communication techniques, 4) infant health care and feeding, 5) fatherhood, and 6) family health after birth. Children of fathers...
### Table 4
Summary of Publications Included in the Realist Analysis Following a Case-Control Design. Realist Review on "How Do Breastfeeding Workplace Interventions Work?"

**CASE-CONTROL DESIGN**

| Lead Author; Publication Year | Study Population | Country | Intervention | Outcomes |
|-------------------------------|------------------|---------|--------------|----------|
| Sahip et al. [58]; 2007       | Expectant fathers of companies with full-time workplace physician | Turkey | 6 education sessions each 3–4 h for expectant fathers: health during pregnancy, pregnancy nutrition + birth, communication techniques, infant health care and feeding, fatherhood, family health after birth | BF initiation within 1 h after birth: OR = 2.38, 95% CI: 1.24–4.61, p < 0.01 |
|                               | Cases (N = 80): men’s characteristics: 32.5% < 30 years of age, 67.5% university education, 81.3% first child; wife’s characteristics: 60.0% < 30 years of age, 60.0% university education, 53.8% working outside the home |       | BF initiation: 100% (case) vs. 98% (control) Mean BF duration: 38.8 ± 34.1 weeks (case) vs. 41.8 ± 24.0 weeks (control) Mean total support score: 137.7 ± 15.1 (case) vs. 124.5 ± 14.9 (control) | NS association between support scores and breastfeeding durations |
|                               | Controls (N = 80): men’s characteristics: 31.3% < 30 years of age, 70.0% university education, 70.0% first child; wife’s characteristics: 60.0% < 30 years of age, 45.0% university education, 48.8% working outside the home |       | Mean BF duration: 38.8 ± 34.1 weeks (case) vs. 41.8 ± 24.0 weeks (control) Mean total support score: 137.7 ± 15.1 (case) vs. 124.5 ± 14.9 (control) | NS differences between cases and controls |
|                               | Country | USA | N/A | BF initiation: 100% (case) vs. 98% (control) |
|                               | Study Population | Case company (N = 131): Large corporation in the US Southeast with lactation program; mean age 33.2 ± 3.8 years; 81.8% White, 8.1% Asian, 2.5% Black or African American, 7.6% other; 96.3% married or living with partner; 15.9% less than college graduate, 50.4% 4-year college, 33.7% advanced degree; Control company (N = 420): Seattle Children’s Hospital; mean age 34.5 ± 2.9 years; 81.3% White, 8.6% Asian, 4.7% Black or African American, 5.4% other; 96.9% married or living with partner; 3.9% less than college graduate, 53.5% 4-year college, 42.6% advanced degree | Country | Taiwan |
|                               | Intervention | Lactation break times | Availability of lactation policy or documentation | BF initiation: 100% (case) vs. 98% (control) Mean BF duration: 38.8 ± 34.1 weeks (case) vs. 41.8 ± 24.0 weeks (control) Mean total support score: 137.7 ± 15.1 (case) vs. 124.5 ± 14.9 (control) |
|                               | Outcomes | BF promotion | Provision of lactation rooms | NS association between support scores and breastfeeding durations |
|                               | Lead Author; Publication Year | Lin et al. [41]; 2020 | Provision of refrigerator to store expressed BM | Provision of child-care facility |
|                               | Study Population | Case companies (N = 1089): Companies accredited as healthy workplaces under Tobacco Control and/or Occupational health Promotion legislation from 2007 to 2008; Control companies (N = 526): Companies without accreditation, randomly selected from the National Business Directory; For breastfeeding outcome: women who returned to work; N = 477 | Country | Taiwan |
|                               | Intervention | Lactation break times | Availability of lactation policy or documentation | BF initiation: 100% (case) vs. 98% (control) Mean BF duration: 38.8 ± 34.1 weeks (case) vs. 41.8 ± 24.0 weeks (control) Mean total support score: 137.7 ± 15.1 (case) vs. 124.5 ± 14.9 (control) |
|                               | Outcomes | BF promotion | Provision of lactation rooms | NS association between support scores and breastfeeding durations |
|                               | Continuing BF after 1 year: | Provision of refrigerator to store expressed BM | Provision of child-care facility |
|                               | • AOR = 3.32, 95% CI:1.90–5.77 if break times are provided | • AOR = 2.50, 95% CI:1.59–3.92 if BF policy or documentation is available | • AOR = 2.35, 95% CI: 1.23–4.45 if refrigerators are provided |
|                               | • AOR = 2.25, 95% CI: 1.45–3.48 if BF is promoted |
|                               | AOR = 2.00, 95% CI: 1.89–4.76 if lactation rooms are provided | AOR = 2.58, 95% CI: 1.40–4.75 if child-care facility is available |
|                               | AOR = 2.35, 95% CI: 1.23–4.45 if refrigerators are provided |
|                               | Lead Author; Publication Year | Hilliard et al. [32]; 2020 | Working women in North Dakota who attempted to continue BF after returning to work outside the home following a birth of a child between 2014 and 2016; Mean maternal age: 30.8 ± 4.1 years; | Study Population | Litwan et al. International Journal for Equity in Health (2021) 20:148 | Page 6 of 25
in the education group had 2.38 times the odds to be breastfed within the first hour after birth than children of fathers in the control group (95% confidence interval (CI): 1.24–4.61). Also, children of fathers in the education group had 3.44 (95% CI: 1.74–6.82) times the odds for exclusive breastfeeding at 3 months, 2.64 (95% CI: 1.36–5.09) times the odds for any breastfeeding at 9 months and 0.19 (95% CI: 0.09–0.37) times the odds for supplementary feeding before 6 months compared to children of fathers in the control group.

**Realist analysis**

To better understand how workplace breastfeeding interventions work and how their influence on breastfeeding outcomes differs in different contexts, we categorized the interventions described in the analyzed articles into 4 types of intervention and 15 intervention categories (Table 10). To develop a CMO framework (Fig. 2), we analyzed the outcomes per intervention category. We concentrated our analysis on the outcomes on changed breastfeeding behavior as well as changes in

| Table 4 Summary of Publications Included in the Realist Analysis Following a Case-Control Design. Realist Review on "How Do Breastfeeding Workplace Interventions Work?" (Continued) |
|---|
| **CASE-CONTROL DESIGN** |
| Maternal race: 97.0% White, 0.6% Black, 0.2% Asian/Pacific Islander, 1% Native American/Alaskan Native, 0.6% mixed race, 0.6% declined; Marital status: 94.0% married, 4.3% cohabitating, 1.0% single, 0.7% other; Income: 0.3% < USD 15,000, 1.1% USD 15,000-24,999, 3.1% USD 25,000-34,999, 6.8% USD 35,000-49,999, 18.0% USD 50,000-74,999, 29.9% USD 75,000-99,999, 40.8% ≥ USD 100,000; Maternal education level: 1.6% high school, 9.1% some college, 12.2% associate degree, 42.0% Bachelor's degree, 6.1% some graduate, 29.0% graduate degree; N = 392 |
| Country | USA |
| Intervention | Infant-friendly business designation incl.: • Workplace lactation policy • Allowance of flexible break times • Provision of private space (other than bathroom) with a source of clean water to wash hands Provision of refrigerator for BM storage |
| Outcomes | BF duration according to designation status: • Total mean duration: 8.62 ± 4.89 months • Designation in 2011 or 2012 and recent recertification: 7.97 ± 5.60 months • Designation later than 2012: 7.69 ± 4.98 months • Designation in 2011 or 2012 but no recertification: 6.07 ± 4.32 months • No designation: 9.00 ± 4.68 months p = 0.30 |
| Lead Author; Publication Year | Cervera-Gasch et al. [57]; 2020 |
| Study Population | Female teachers/researchers or administration/service staff at either Universitat Jaume (UJI) or Universidad de Sevilla (US) who gave birth in the past 10 years and were employed at either UJI or US at the time of delivery and/or BF; Universitat Jaume (case): N = 103 Maternal education level: 1% secondary education, 99% university studies Universidad de Sevilla (control): N = 198 Maternal education level: 1% primary education, 11.1% secondary education, 87.9% university studies |
| Country | Spain |
| Intervention | Universitat Jaume (UJI) • 4 designated BF areas • BF education Universidad de Sevilla (US) • No lactation rooms • No lactation support program |
| Outcomes | Intention to BF: 93.2% (UJI) vs. 88.4% (US), p = 0.051 Intention to continue BF after RTW: 77.7% (UJI) vs. 66.7% (US), p = 0.580 Continued BF after RTW: 71.8% (UJI) vs. 50.5% (US), p = 0.001 BF duration • UJI: 15.5% < 6 months, 13.6% 6–12 months, 28.2% 1–2 years, 32.0% > 2 years • US: 39.9% < 6 months, 18.2% 6–12 months, 16.7% 1–2 years, 10.6% > 2 years • p < 0.001 |

95% CI 95% confidence interval, AOR adjusted odds ratio, BF breastfeeding, BM breastmilk, EBF exclusive breastfeeding, N/A not applicable, NS not significant, OR odds ratio, RTW return to work
perceived workplace breastfeeding culture (e.g., how common breastfeeding at the workplace is), manager/supervisor support, co-worker support and in the physical environment. It is to mention, that workplace breastfeeding outcomes can also lead to additional outcomes that were out of scope of this review such as job satisfaction [22, 31].

Our analysis revealed three potential mechanisms or factors that might explain how workplace interventions influence breastfeeding habits at the workplace: 1) having more time to breastfeed during work, 2) awareness of the intervention among mothers, supervisors and co-workers and 3) change in culture, management/supervisor support, co-worker support and/or physical environment. Having more time to breastfeed can be directly achieved for example by providing lactation breaks or flexible working hours or indirectly for example by changing the physical environment (e.g., providing lactation rooms [43, 54]) or co-worker support (e.g., by raising the understanding of co-worker through a communication strategy such that the co-worker support flexible work schedule). The mechanism of awareness about the intervention acts directly on the mother as well as indirectly through raising awareness of others; e.g. supervisors and co-workers who can then direct the mother to the lactation program. As long as the mother is not aware of the intervention, she cannot use it, and thus, her breastfeeding habit at the workplace will not change due to the intervention [25, 43, 44]. Supervisor awareness was also important in order to be able to advise their pregnant employees of corporate lactation programs. Therefore, changes in culture, management/supervisor support, co-worker support and/or physical environment are mechanisms and associated with changes in breastfeeding habits of employed mothers [23, 31, 33, 35, 36, 38, 41, 42].

The analysis of outcomes based on their intervention category also led to the identification of important contextual factors. The context in which the intervention is implemented determines whether it is sufficient to affect breastfeeding outcomes. We identified the following contexts: breastfeeding–/family-friendly business designations [32, 41], distance between workplace and infant [50, 53, 54], flexibility of work schedule/workload [38], marital status [24], maternal education level [24, 31, 57], marital health conditions [38], number of offered lactation services [26, 28, 34], parity [57], race/ethnicity [24, 26], shift work [29, 40, 42–44], time of registration to program [26, 34], type of employment (full-time vs. part-time) [26], type of salary (fixed vs. hourly) [24, 39], type of workplace [24, 42–44]. As an example of how different work-related contexts require different implementation mechanisms, or, lead to different outcomes for similar interventions, we will concentrate on the context of distance between workplace and infant as well as the contexts of flexibility of work schedule/workload, shift work and type of workplace.

The sole implementation of a workplace breastfeeding intervention was not always sufficient to cause a change in breastfeeding habits at the workplace. We found that a large distance between the workplace and the location of the infant as well as commute times are a major barrier for continued breastfeeding after returning to work. Mothers whose children are living far apart from them described the large distance between them and their infants as a reason to stop breastfeeding after return to work; despite the presence of lactation break policies [50, 53], lactation facilities [50] or even the offer of a drop-off service that brings expressed breastmilk to the local bus and van station from where the breastmilk is transported to rural areas, where the infant is living [50]. Underlying reasons seem to be different: Mothers in Thailand report that they fear that their breastmilk will be spoiled during the long transportation and that grandmothers, who are caring for the infant, lack the knowledge how to handle frozen/expressed breastmilk [50], in China the legal provision of one-hour feeding break for working mothers of infants aged younger than 1 year is insufficient for mothers whose children are not near the workplace since the provision of lactation facilities is not legally required, thus, requiring mothers to travel to their infant to feed them [53]. While the example in Thailand shows that mechanisms outside the work environment are influential, the example in China

| Table 5 Summary of Publications Included in the Realist Analysis Following a Cohort Design. Realist Review on “How Do Breastfeeding Workplace Interventions Work?” | COHORT DESIGN |
|---|---|
| Lead Author; | Brasileiro et al. [46]; 2012 |
| Publication Year | |
| Study Population | Formally working mothers who RTW before the child had reached six months of life; Maternal age: 52.0% ≤ 28 years; Paternal age: 53.0% ≤ 30 years; Marital status: 94.5% with partner; Socioeconomic level: 14% high, 38.0, 12.4% low; N = 200 |
| Country | Brazil |
| Intervention | Daycare center Lactation facilities |
| Outcomes | Discontinue BF before 4 months: Not having a 30-min break every work shift: OR = 4.10, 95% CI: 1.81–9.26, p < 0.0001 NS for presence of daycare center at the workplace NS for number of working hours per day |
| | NS for presence of lactation facilities |

95% CI 95% confidence interval, BF breastfeeding, NS not significant, OR odds ratio, RTW return to work
**Table 6** Summary of Publications Included in the Realist Analysis Following a Cross-Sectional Design. Realist Review on “How Do Breastfeeding Workplace Interventions Work?”

| CROSS-SECTIONAL DESIGN |
|-------------------------|
| Lead Author; Publication Year | Jacknowitz [40]; Chapter 4; 2004 |
| Study Population | National Longitudinal Survey of Youth 1979, analysis is limited to birth between 1989 and 1999; Birth mother must have worked ≥20 h per week during six months prior to birth; Maternal age: 31.4 ± 3.34 years; Maternal race: 56.7% Non-Hispanic White, 23.8% Non-Hispanic Black, 19.5% Hispanic; Marital status: 82.9% husband/partner present; BF initiation: 59.6%; Any BF rate at 6 months: 19.5%; N = 893 |
| Country | USA |
| Intervention | Employer-sponsored childcare Flexible work schedule Hours worked at home |
| Outcomes | Employer-sponsored childcareBF initiation: NS BF at 6 months: 11.4% higher probability of BF at 6 months with employer-sponsored childcare than without, p < 0.01 Flexible scheduleBF initiation: NS BF at 6 months: NS Hours worked at homeBF initiation: every 8 h worked at home per week is associated with 0.7% higher probability of BF initiation, p < 0.05 BF at 6 months: every 8 h worked at home per week is associated with 0.5% higher probability of BF at 6 months, p < 0.01 Shift workBF initiation: NS BF at 6 months: NS |
| Lead Author; Publication Year | Ortiz et al. [39]; 2004 |
| Study Population | Participants of corporate lactation programs of five companies who gave birth between April 19, 1993 and December 31, 1997 and full-time employed before taking maternity leave; Maternal race (only 4 of the 5 companies provided demographic data): 0.6% American Indian, 14.1% Asian/Pacific Islander, 6.2% African American, 26.8% Hispanic, 52.3% White; N = 462 |
| Country | USA |
| Intervention | Corporate management policies guaranteeing that BF employees will be supported Private, locked rooms for pumping Provision of electric breast pump Breast pump instructions BF class BF education and lactation consultations BF telephone consultations 24/7 |
| Outcomes | BF initiation: 97.5% Any BF rate at 6 months: 57.8% Pumped at work: 152 of 194 (salaried) vs. 104 of 157 (hourly), p ≤ 0.01 Mean age of infant when pumping was discontinued: 9.1 ± 4.11 months • 9.0 ± 4.26 months (full-time) vs. 8.6 ± 2.95 (part-time), p = 0.72 • 8.7 ± 3.92 months (salaried) vs. 9.3 ± 4.51 (hourly), p = 0.31 |
| Lead Author; Publication Year | Chen et al. [44], 2006 |
| Study Population | Female employees of Company T who have taken maternity leave between January 1999 and April 2003; Maternal age: 6.6% 20–24 years, 42.0% 25–29 years, 40.7% 30–34 years, 10.7% ≥35 years; Mean maternal age: 29.8 ± 3.7 years; Maternal education level: 51.6% ≤ high school, 48.2% ≥ college; Worksite: 82.1% clean room; Shift work: 77.2% yes; Flextime: 29.4% yes; N = 998 |
| Country | Taiwan |
| Intervention | Lactation rooms Lactation break times |
| Outcomes | OR for ever breastfed: |
### Table 6
Summary of Publications Included in the Realist Analysis Following a Cross-Sectional Design. Realist Review on “How Do Breastfeeding Workplace Interventions Work?” (Continued)

**CROSS-SECTIONAL DESIGN**

- **Awareness of lactation room (yes vs. no):** 1.60, 95% CI: 1.14–2.24, \( p = 0.006 \)
- **Awareness of lactation breaks (yes vs. no):** 0.87, 95% CI: 0.59–1.28, \( p = 0.674 \)
- **Awareness of lactation breaks among clean room workers (yes vs. no):** 0.84, 95% CI: 0.56–1.26, \( p = 0.399 \)
- **Awareness of lactation room among office workers (yes vs. no):** 2.83, 95% CI: 0.99–8.06, \( p = 0.052 \)
- **Awareness of lactation breaks among office workers (yes vs. no):** 1.14, 95% CI: 0.33–3.95, \( p = 0.833 \)
- **High awareness of policy (office vs. clean room):** 2.38, 95% CI: 0.65–8.71, \( p = 0.189 \)

OR for continued breastfeeding after returning to work:

- **Awareness of lactation room (yes vs. no):** 2.71, 95% CI: 1.19–6.15, \( p = 0.017 \)
- **Awareness of lactation breaks (yes vs. no):** 2.68, 95% CI: 1.57–4.58, \( p < 0.001 \)
- **Awareness of lactation breaks among clean room workers (yes vs. no):** 2.06, 95% CI: 0.78–5.40, \( p = 0.143 \)
- **Awareness of lactation room among office workers (yes vs. no):** 2.15, 95% CI: 1.00–4.26, \( p = 0.028 \)
- **Awareness of lactation breaks among office workers (yes vs. no):** 2.15, 95% CI: 1.09–4.26, \( p = 0.028 \)
- **High awareness of policy (office vs. clean room):** 8.65, 95% CI: 2.48–30.18, \( p = 0.001 \)

Lead Author; Publication Year

**Johnston Balkam** [34], 2006

**Study Population**
Women who had participated in employer’s corporate lactation program within the last 3 years prior to the start of the study and who were still employed by the organization;
Maternal race: 69% White, 9% Chinese, 8% Black, 5% Spanish, Hispanic or Latina, 3% Filipina, 3% Asian Indian, 2% Korean, 3.6% other;
Maternal education level: 0.8% high school diploma, 10% some college or technical school, 20% Bachelor’s degree, 20% Master’s degree, 48% doctoral degree;
Marital status: 97% married, 3% not married;
Household income: 30% < USD 100,000, 38% USD 100,000–149,999, 27% ≥ USD 150,000;
\( N = 128 \)

**Country**
USA

**Intervention**
Prenatal BF classes
Telephone support by lactation consultants for new mothers during maternity leave
RTW consultation with lactation consultants
Ongoing lactation support from lactation consultants during after RTW

**Outcomes**
Time of program registration and type of feeding at 6 months
- Registration before birth: 45% EBF vs. 27% any formula
- Registration around birth: 13% EBF vs. 16% any formula
- \( p < 0.05 \)

Number of received services and type of feeding at 6 months:
- 1 service: 10% EBF vs. 14% any formula
- 2 service: 13% EBF vs. 14% any formula
- 3 service: 20% EBF vs. 10% any formula
- 4 service: 14% EBF vs. 5% any formula
- \( p < 0.05 \)

**Lead Author; Publication Year**
**Dabritz et al.** [25], 2009

**Study Population**
Birth mothers who resided in Yolo County, CA at the time of delivery;
Maternal age: 15% < 20 years, 25% 20–24 years, 47% 25–34 years, 13% ≥35 years;
Maternal ethnicity: 5% Asian, 53% White, 6% others;
Maternal education level: 11% ≤8th grade, 15% 9th–11th grade, 73% ≥12th grade;
\( N = 399 \) of which 214 returned to school/work after giving birth

**Country**
USA

**Intervention**
Lactation room
Lactation break times
Workplace/school lactation policy

**Outcomes**
201 of 214 (94%) infants were at least once breastfed

Type of feeding
- Presence of lactation room:
  - Yes: 78% (almost EBF) vs. 68% (partial BF) vs. 64% (no BF)
  - No: 13% (almost EBF) vs. 28% (partial BF) vs. 26% (no BF)
  - Did not know: 6% (almost EBF) vs. 4% (partial BF) vs 7% (no BF)
  - \( p = 0.094 \)
- Lactation break times:
  - Yes: 92% (almost EBF) vs. 81% (partial BF) vs. 79% (no BF)
  - No: 2% (almost EBF) vs. 4% (partial BF) vs. 7% (no BF)
  - Did not know: 6% (almost EBF) vs. 15% (partial BF) vs 14% (no BF)
  - \( p = 0.22 \)
- Knowledge of lactation policy:
  - Yes: 79% (almost EBF) vs. 61% (partial BF) vs. 61% (no BF)
### Table 6 Summary of Publications Included in the Realist Analysis Following a Cross-Sectional Design. Realist Review on “How Do Breastfeeding Workplace Interventions Work?” (Continued)

#### CROSS-SECTIONAL DESIGN

- No: 21% (almost EBF) vs. 39% (partial BF) vs. 39% (no BF)
  \( p = 0.018 \)

| Lead Author; Publication Year | Study Population | Interventions | Outcomes |
|-------------------------------|------------------|---------------|----------|
| Balkam et al. [26]; 2011      | Female employees working on the employer's campus, who had finished workplace lactation program within 3 years prior to study and were still employed by the organization in April 2005; Mean maternal age at delivery: 34.4 ± 4.0 years; Maternal status: 97% married, 3% not married; Maternal race: 70% White, 30% non-White; Maternal education level: 48% doctoral degree, 20% Master's degree, 20% Bachelor's degree, 10% some college or tech school, 2% high school diploma or less; Household income: 31% < USD 100,000, 40% USD 100,000-149,999, 29% ≥ USD 150,000; | Prenatal BF education | EBF 6 months: |
|                               |                  | Telephone support | Time of registration: 62.6% before birth vs. 43.2% around RTW; \( p < 0.05 \) |
|                               |                  | RTW consultation  | Prenatal education: 57.4% yes vs. 57.5% no; NS |
|                               |                  | Lactation room    | Telephone support: 62.8% yes vs. 45.2% no; \( p < 0.05 \) |
|                               |                  |                 | RTW consultation: 68.0% yes vs. 41.5% no; \( p < 0.05 \) |
|                               |                  |                 | Lactation room: 59.8% vs. 48.4% no; NS |
|                               |                  |                 | # services received: 41.9% 1 service, 47.1% 2 services, 66.6% 3 services, 75.0% 4 services, \( p < 0.05 \) |
| Weber et al. [52]; 2011       | Female employees of Sydney South West Area Health Service who took maternity leave between January 2008 and August 2009 with a valid home address; Mean maternal age: 35 years; Maternal background: 66% English speaking, 34% non-English speaking; Maternal status: 97% married/de-factor, 1% divorced/separated, 2% never married; Maternal education level: 84% university, 13% technical or trade certificate or diploma, 3% less than tertiary education, 1% other; Household income: 10% < AUD 39,999, 33% AUD 40,000-79,999, 58% ≥ AUD 80,000; | Flexible work practice | 98% initiated BF |
|                               |                  |                 | Discontinued BF: |
|                               |                  |                 | 13% at 3 months |
|                               |                  |                 | 24% at 6 months |
|                               |                  |                 | 59% intended to BF after RTW, 40% BF after RTW |
|                               |                  |                 | How BF and work was combined: |
|                               |                  |                 | 37% BF before and after work/infant formula during work hours |
|                               |                  |                 | 36% BF before and after work/expressed BM during work hours |
|                               |                  |                 | 1% BF before, after and during work hours |
|                               |                  |                 | 26% other |

| Bai et al. [33]; 2013         | Working mothers aged ≥18 years who are currently BF or had BF within 18 months prior to the beginning of the study and who were either staff or faculty at a higher-education institution or who gave birth in the spring and fall of 2010 in one hospital obstetrics unit; Mean maternal age: 33.8 ± 6.0 years; Maternal education level: 2.7% high school, 15.0% some college, 40.7% college graduate, 41.6% postgraduate; | Flexible work practice | 98% initiated BF |
|                               |                  |                 | Discontinued BF: |
|                               |                  |                 | 13% at 3 months |
|                               |                  |                 | 24% at 6 months |
|                               |                  |                 | 59% intended to BF after RTW, 40% BF after RTW |
|                               |                  |                 | How BF and work was combined: |
|                               |                  |                 | 37% BF before and after work/infant formula during work hours |
|                               |                  |                 | 36% BF before and after work/expressed BM during work hours |
|                               |                  |                 | 1% BF before, after and during work hours |
|                               |                  |                 | 26% other |
| Country | USA | Taiwan | USA |
|---------|-----|--------|-----|
| **Intervention** | N/A | Lactation facilities (independent space or no independent space, only curtains for separation) | Prenatal BF classes |
| **Outcomes** | Perceived workplace lactation support and EBF duration: | OR for continued BF for 1–6 months after return to work: | OR for continued BF for > 6 months after return to work: |
| | • Technical support: r = 0.71, p = 0.01 | • Using lactation breaks (yes vs. no): 33.1, 95% CI: 18.0–64.1, p < 0.0001 | • Using lactation breaks (yes vs. no): 51.6, 95% CI: 31.2–121.6, p < 0.0001 |
| | • Workplace environment: r=0.36, p = 0.01 | • Supportive co-worker (yes vs. no): 2.53, 95% CI: 2.21–5.32, p = 0.0133 | • Supportive co-worker (yes vs. no): 2.78, 95% CI: 1.14–6.76, p = 0.0235 |
| | • Break time: r = 0.05, p = 0.52 | • Supportive supervisor (yes vs. no): 2.45, 95% CI: 1.17–5.05, p = 0.0156 | • Supportive supervisor (yes vs. no): 2.44, 95% CI: 1.06–5.61, p = 0.0355 |
| | • Workplace policies: r = 0.13, p = 0.24 | • NS difference for worksite, shift work, daily working hours, type of lactation room, awareness of lactation breaks | • NS difference for worksite, shift work, awareness of lactation breaks |

| Lead Author; Publication Year | Tsai [42]; 2013 | Cohen et al. [29]; 2014 |
|------------------------------|-----------------|------------------------|
| **Study Population** | Female employees of Company C who have taken maternity leave between January 2009 and January 2011; Maternal age: 23.9% 20–29 year, 74.6% 30–39 years, 1.5% ≥40 years; Maternal education level: 28.3% high school education and below, 71.7% college and above; Worksite: 44.8% clean room, 55.2% office; Shift work: 46.7% yes; Work hours per day: 16.7% 8 h, 83.3% 9–14 h; N = 715 | Mothers employed at one of the two participating companies and who participated in the onsite corporate lactation program between 1989 and 1992, returned to work for at least 16 h per week after maternity leave; Utilities company (1992): • Average age: 29.5 years (range: 23–41 years) • Average salary: USD 36,000 (range: USD 24,000-50,000) • Average BF duration: 7.4 months (range: 3–14 months) • Maternal race/ethnic origin: 37.9% White, 20.7% African American, 13.8% Asian, 24.1% Hispanic, 3.4% other Aeronautics company (1992): • Average age: 33.1 years (range: 26–40 years) • Average salary: N/A • Average BF duration: 8.4 months (range: 2–16 months) • Maternal race/ethnic origin: 60.0% White, 10.0% African American, 10.0% Asian, 20.0% Hispanic, 0% other N = 187 |
| **Country** | USA | USA |
| **Intervention** | N/A | Prenatal BF classes |
| **Outcomes** | OR for continued BF for 1–6 months after return to work: | Perinatal counseling regarding lactation and RTW lactation maintenance services Provision of electric breast pump |
| | • Women returning to work BF and pumping: 29% | |
| | • Women still in program 6 months after birth: 23% | |
| | • Women still in program 1 year after birth (1991): 8% | |
| | • Women returning to work BF and pumping: 67% | |
| | • Women still in program 6 months after birth: 47% | |
| | • Women still in program 1 year after birth (1991): 9.5% | |

Table 6 Summary of Publications Included in the Realist Analysis Following a Cross-Sectional Design. Realist Review on “How Do Breastfeeding Workplace Interventions Work?” (Continued)
| Lead Author; Publication Year | Study Population | Country | Intervention | Outcomes |
|-------------------------------|------------------|---------|--------------|----------|
| Spatz et al. [27]; 2014       | Female employees of Children’s Hospital of Philadelphia (CHOP) who filed for maternity leave between 2007 and 2011 and had a CHOP email address; Maternal ethnicity: 75.8% White/Caucasian, 13.0% Black/African American, 7.9% Asian/Pacific Islander, 2.9% Hispanic American, 0.4% American Indian/Alaskan Native; maternal age at delivery (years): 0.2% < 20, 1.8% 20–24, 24.0% 25–29, 47.9% 30–34, 26.1% ≥ 35; N = 545 | USA | Employee lactation policy, Personal pump purchase program, Pump loaner program from off-campus locations, Prenatal BF class, BF resource nurse class, Lactation rooms | 94.5% initiated BF, EBF 3 months: 62.9%, EBF 6 months: 35.0% |
| Tsai [43]; 2014               | Female employees of Company C who have taken maternity leave between January 2009 and January 2011; Maternal age: 23.9% < 30 years, 76.1% ≥ 30 years; Maternal education level: 28.3% ≤ high school, 71.7% ≥ college; Worksite: 44.8% clean room, 55.2% office; Shift work: 46.7% yes; Work hours per day: 16.7% 8 h, 83.3% 9–14 h; N = 715 | Taiwan | Lactation room with table, chair, sink, electrical outlets and refrigerator, 2 lactation breaks of 30 min each per working day | Differences in use of breast-pumping breaks according to age (\(p = 0.0459\)), maternal education (\(p < 0.0001\)), husband’s education (\(p = 0.0002\)), worksite (\(p < 0.0001\); clean room uses less often, office uses more often), shift work (\(p < 0.0001\); shift workers use less often), NS difference according to work hours per day (\(p = 0.5164\)); Positive association between the use of lactation breaks after returning to work and awareness about lactation rooms (\(p = 0.0173\)), breast-pumping breaks policy (\(p < 0.0001\)), support from supervisor (\(p < 0.0001\)) and coworkers (\(p < 0.0001\)), encouragement to use lactation room from environmental health nurses (\(p < 0.0001\)) and provision of lactation consultant by employer (\(p = 0.0074\)); Negative association between the use of lactation breaks after returning to work and feeling of embarrassment (\(p = 0.0046\)), perception of inefficiency (\(p < 0.0001\)) and believing that lactation breaks would affect supervisor’s assessment of performance (\(p = 0.0079\)). \(\text{OR for intention to use breast-pumping break after returning to work:}
- \text{Awareness of lactation room: 2.27, 95% CI: 1.15–4.48, } p = 0.0208
- \text{Awareness of lactation breaks: 4.70, 95% CI: 2.90–7.88, } p < 0.0001
- \text{Provision of lactation consultant: 0.97, 95% CI: 0.75–1.30, } p = 0.8207
- \text{Guilty feelings when using breast-pumping breaks: 0.81, 95% CI: 0.60–1.09, } p = 0.3148
- \text{Coworker support: 1.76, 95% CI: 1.21–2.56, } p = 0.0005
- \text{Supervisor support: 1.47, 95% CI: 0.89–2.45, } p = 0.1522
- \text{Encouragement by environmental health nurses: 1.16, 95% CI: 0.94–1.43, } p = 0.2207
- \text{Perception of work inefficiency: 0.55, 95% CI: 0.37–0.82, } p = 0.0031
- \text{Perception of influenced supervisor’s work evaluation: 1.07, 95% CI: 0.71–1.60, } p = 0.7470
- \text{Awareness of BF benefits: 1.08, 95% CI: 1.02–1.13, } p = 0.0050 |
| Basrovı et al. [55]; 2015      | Female employees of five workplaces in Jakarta whose children were between 6 and 36 months of age and who completed the questionnaire between December 2012 and February 2013; Maternal education level: 24.7% low, 38.7% middle, 36.6% high; Status of home: 36.6% owned, 41.4% rented, 22.0% owned by relatives; N = 186 | Indonesia | Lactation room with refrigerator, hand washing facilities and dedicated seat or bed | OR EBF: \(\text{Workplace (office vs. factory): 3.33, 95% CI: 1.77–6.25, } p < 0.001\), \(\text{Proper dedicated BF facility (yes vs. no): 2.62, 95% CI: 1.27–5.38, } p = 0.008\), \(\text{BF support program (yes vs. no): 5.93, 95% CI: 1.78–19.79, } p = 0.001\) |
Table 6 Summary of Publications Included in the Realist Analysis Following a Cross-Sectional Design. Realist Review on “How Do Breastfeeding Workplace Interventions Work?” (Continued)

### CROSS-SECTIONAL DESIGN

| Lead Author; Publication Year | Study Population | Country | Intervention | Outcomes |
|--------------------------------|------------------|---------|--------------|----------|
| Froh et al. [38]; 2016 | Female employees of Children’s Hospital of Philadelphia (CHOP) who filed for maternity leave between 2007 and 2011 and had a CHOP email address; 
\[N = 410\] | USA | • Employee lactation policy  
• Personal pump purchase program  
• Pump loaner program from off-campus locations  
• Prenatal BF class  
• BF resource nurse class  
• Lactation rooms | 5 major themes  
• Positive reflections  
• Non-supportive environment/work culture  
• Accessible resources but work culture does not allow to make use of the resources  
• Perception of non-supportive supervisors and co-workers – missing understanding for situation, understaffed departments, no knowledge about needed pump frequency  
• Supportive environment/work culture  
• Environment made the mothers feel comfortable with their BF choice  
• Accessibility of resources  
• Not all employees are aware of resources or know how to access them  
• Difficulties navigating work and BF  
• Internal barriers |
| Lee et al. [45]; 2015 | Disproportionate probability sample based on maternal residence in 25 cities/counties in Taiwan: Mothers aged ≥20 years who gave birth in 2008, 2009, 2010 or 2011 and infant was alive at the time of the interview; 
Maternal age:  
\[20–24\] years: 7.7% (2008), 6.5% (2009), 7.5% (2010), 7.2% (2011)  
\[25–29\] years: 28.4% (2008), 26.9% (2009), 28.4% (2010), 26.9% (2011)  
\[30–34\] years: 40.9% (2008), 42.7% (2009), 42.8% (2010), 43.1% (2011)  
\[≥35\] years: 23.0% (2008), 23.9% (2009), 21.3% (2010), 22.9% (2011)  
Maternal education level:  
\[≤julior high school: 12.2% (2008), 8.3% (2009), 7.0% (2010), 6.0% (2011)  
• High school: 38.2% (2008), 31.6% (2009), 29.7% (2010), 29.1% (2011)  
• Vocational school: 26.4% (2008), 26.6% (2009), 21.8% (2010), 21.6% (2011)  
• ≥university: 23.3% (2008), 33.5% (2009), 41.5% (2010), 43.3% (2011)  
Employed outside the home: 65.0% (2008), 69.6% (2009), 57.0% (2010), 55.5% (2011);  
\[N = 2163 (2008); 1453 (2009); 11,011 (2010); 12,410 (2011)\] | Taiwan | Lactation room | OR of EBF: 2.68, 95% CI: 2.44–2.94, \(p < 0.001\)  
OR of any BF: 3.25, 95% CI: 2.99–3.53, \(p < 0.001\) |
| Kozhimannil et al. [28]; 2016 | Women who gave birth in U.S. hospital between July 2011 and June 2012 and who were employed at the time of the follow-up survey between January and April 2013;  
Maternal age: 27.5% 18–24 years, 25.9% 25–29 years, 26.8% 30–34 years, 19.7% ≥35 years;  
Maternal race: 62.3% White, 13.7% Black, 18.0% Hispanic, 6.1% other/multiple race;  
Maternal education level: 26.3% ≤high school, 28.4% some college/associate’s degree, 27.3% Bachelor’s degree, 18.0% graduate education/degree;  
Income: 32.3% ≤USD 52,300, 47.4% USD 52,301-102,000, 20.3% > USD 102,001;  
\[N = 550\] | USA | Lactation break times  
Private lactation space | PP employment plans affected BF-related decision  
• Sufficient break time (yes): 46.9%, \(p = 0.302\)  
• Private room (yes): 46.7%, \(p = 0.379\)  
• Break time + private room (yes): 44.0%, \(p = 0.122\)  
Employment posed a challenge to BF  
• Sufficient break time (yes): 35.2%, \(p = 0.371\) |
Table 6 Summary of Publications Included in the Realist Analysis Following a Cross-Sectional Design. Realist Review on “How Do Breastfeeding Workplace Interventions Work?” (Continued)

| CROSS-SECTIONAL DESIGN |
|-------------------------|
| Private room (yes): 33.3%, \( p = 0.918 \) |
| BF intention at the end of pregnancy |
| Sufficient break time (yes): \( p = 0.17 \) |
| - BF only: 62.6% |
| - Formula only: 10.7% |
| - BF + formula: 26.7% |
| Private room (yes): \( p = 0.163 \) |
| - BF only: 57.7% |
| - Formula only: 11.3% |
| - BF + formula: 31.1% |
| Break time + private room (yes): \( p = 0.189 \) |
| - BF only: 59.7% |
| - Formula only: 10.6% |
| - BF + formula: 29.7% |

| BF status at 6 months |
|------------------------|
| Sufficient break time (yes): \( p = 0.030 \) |
| - BF only: 71.4% |
| - Formula only: 14.7% |
| - BF + formula: 14.0% |
| Private room (yes): \( p = 0.677 \) |
| - BF only: 75.7% |
| - Formula only: 11.9% |
| - BF + formula: 12.4% |
| Break time + private room (yes): \( p = 0.722 \) |
| - BF only: 75.1% |
| - Formula only: 12.4% |
| - BF + formula: 12.5% |

| Mean EBF duration (months) |
|-----------------------------|
| Sufficient break time (yes): 5.37, \( p = 0.397 \) |
| Private room (yes): 5.89, \( p = 0.002 \) |
| Break time + private room (yes): 5.64, \( p = 0.088 \) |

| AOR of EBF at 6 months |
|-------------------------|
| Reasonable break time to express milk: 2.593, 95% CI: 1.00–6.71 |
| Private room to express milk: 2.669, 95% CI: 0.43–16.48 |
| Break time + private room: 2.255, 95% CI: 1.03–4.95 |

| AOR of any BF at 6 months |
|---------------------------|
| Reasonable break time to express milk: 3.004, 95% CI: 1.23–7.32 |
| Private room to express milk: 0.555, 95% CI: 0.12–2.57 |
| Break time + private room: 1.946, 95% CI: 0.88–4.28 |

Lead Author; Publication Year
Paddock [24], 2017

Study Population
Cornell employees with at least one dependent child aged 12 years or younger in February 2009; Maternal education level: 47.7% graduate degree, 34.3% college degree, 12.2% attended college, 5.6% completed high school; \( N = 919 \)

Country
USA

Intervention
Financial support to spend on any legal childcare for children up to age 13 years

Outcomes
BF was associated with higher education, marriage, higher income, academic position bs. Hourly position and work unit
Inflexible work schedule as reason for not initiating/stopping BF
Missing information about BF rights as reason for not initiating/stopping BF
Flexible work schedule/availability to work part-time as BF facilitator

Lead Author; Publication Year
Butudom [50], 2018; quantitative analysis

Study Population
Mothers working for Company A and who took maternity leave between June and December 2016; Maternal age: 5.6% < 25 years, 38.4% 25–29 years, 32.4% 30–34 years, 20.4% 35–39 years, 3.2% ≥40 years; Maternal education level: 15.3% < high school, 56.9% high school, 21.8% vocational degree, 6.0% ≥ Bachelor's degree; Marital status: 10.6% single, 2.3% separated/divorced, 87.0% married;
Monthly income: 10.6% < Baht 10,000, 87.0% Baht 10,000-19,999, 0.9% Baht 20,000-29,999, 1.4% ≥ Baht 30,000; \( N = 216 \)

Country
Thailand

Intervention
Fully equipped lactation room
Breast pumping equipment
Refrigerator to store expressed BM
BM drop-off service
BF training program
# Table 6: Summary of Publications Included in the Realist Analysis Following a Cross-Sectional Design. Realist Review on “How Do Breastfeeding Workplace Interventions Work?” (Continued)

| CROSS-SECTIONAL DESIGN |
|-------------------------|
| **Outcomes** | EBF rate: 76.9% at 1 month, 46.3% at 3 months, 7.4% at 6 months  
Reported reasons to stop BF: 36% insufficient milk supply, 31% infant lives with grandmother too far away, 12% RTW, 21% other reasons |
| **Lead Author; Publication Year** | Butudom [50]; 2018; qualitative analysis |
| **Study Population** | Mothers working for Company A and who took maternity leave between June and December 2016;  
Mean maternal age: 31.70 ± 4.46 years;  
Monthly income: 16.7% < Baht 10,000, 73.3% Baht 10,000-19,999, 10.0% ≥ Baht 20,000;  
N = 30 |
| **Country** | Thailand |
| **Intervention** | Fully equipped lactation room  
Breast pumping equipment  
Refrigerator to store expressed BM  
BM drop-off service  
BF training program |
| **Outcomes** | BF policy was seen as helpful to decide to BF the infant  
Impact of RTW on BF  
Infant living in distant location: grandmothers are lacking knowledge how to feed frozen BM; mothers are concerned that expressed/frozen BM will be spoiled because of the long transport (2–3 days)  
BM transportation: difficult to send expressed/frozen BM because of inadequate public transport  
Importance of social support during BF |
| **Lead Author; Publication Year** | Payton [35]; 2018; quantitative analysis |
| **Study Population** | Women BF a biological child within the last 5 years while being full-time employed by organization who is member of the Greater Philadelphia Business Coalition on Health or the Pittsburgh Business Group on Health;  
Maternal mean age: 33.65 ± 4.07 years;  
Maternal race: 7% Asian, 11% Black or African American, 76% White, 4% mixed, 3% other;  
Maternal education level: 2% high school, 12% some college, 45% college degree, 42% graduate degree, 1% not documented;  
Marital status: 22% married/with partner, 1% not married/with partner, 78% not documented;  
N = 199 |
| **Country** | USA |
| **Intervention** | N/A |
| **Outcomes** | 64% BF as long as intended  
BF durations and achieved BF goals  
• 77% of mothers who BF for > 6 months, BF for as long as intended  
• 51% of mothers who BF for 3–6 months, BF for as long as intended  
• 37% of mothers who BF between 6 weeks and 3 months, BF for as long as intended  
• 25% of mothers who BF for < 6 weeks, BF for as long as intended  
• p < 0.001  
BF location at workplace and achieved BF goals  
• 58% of mothers who pumped in a bathroom did not BF for as long as intended  
• 29% of mothers who did not pump in a bathroom BF for as long as intended  
• p < 0.001  
Significant association between BF intention and perceptions of workplace lactation support with BF duration, p < 0.001  
Significant association between utilization of workplace lactation support and BF duration for ≥ 6 months, p < 0.001 |
| **Lead Author; Publication Year** | Payton [35]; 2018; qualitative analysis |
| **Study Population** | Women BF a biological child within the last 5 years while being full-time employed by organization who is member of the Greater Philadelphia Business Coalition on Health or the Pittsburgh Business Group on Health;  
Maternal mean age: 32.86 ± 3.72 years;  
Maternal race: 14% Black or African American, 64% White, 21% other/mixed;  
Maternal education level: 21% some college, 17% college degree, 58% graduate degree;  
Marital status: 93% married/with partner, 7% not married/with partner;  
N = 14 |
| **Country** | USA |
| **Intervention** | N/A |
| **Outcomes** | Main themes from interviews with BF employees  
• Cognitive influences on behavior  
• Environmental influences on behavior  
• Supporting behavioral factors |
Table 6 Summary of Publications Included in the Realist Analysis Following a Cross-Sectional Design. Realist Review on “How Do Breastfeeding Workplace Interventions Work?” (Continued)

| Lead Author; Publication Year | Study Population | Country | Intervention | Outcomes |
|-------------------------------|------------------|---------|--------------|----------|
| Santos et al. [47]; 2018      | Mothers working at a higher education institution but not being a student or resident at the time of the birth of the infant as well as at the time of the study; infants attending childcare center at the mother’s workplace; Maternal age: 47.8% < 35 years, 52.2% ≥ 35 years; Maternal education level: 65.2% higher education, 26.1% vocational education, 8.7% medium; N = 46 | Brazil | Child-care center | Lactation breaks (2 x 30-min breaks or 1-h reduction in workload) |
| Wambach et al. [30]; 2018     | Registered nurses who have been employed at the hospital for a minimum of 2 years and concurrently BF or had done so within the past 12 months; Maternal education level: 11.5% associate’s degree, 78.2% Bachelor’s degree, 10.3% Master’s degree; Maternal race: 1.3% Asian, 98.7% White; Maternal ethnicity: 1.3% Hispanic or Latino, 98.7% non-Hispanic or non-Latino; N = 78 | USA | N/A | 94% had designated lactation space |
| Chen et al. [53]; 2019; quantitative analysis | Mothers with children under 12 months who are living in one of the 12 randomly chosen county level regions (4 urban cities, 4 small and medium sized cities, 2 rural areas, 2 poor rural areas); Mean maternal age: 29.15 ± 5.11 years; Maternal education level: 8.08% ≤ primary school, 36.53% middle school, 18.04% high/vocational school, 37.35% ≥ college; Employment status: 69.66% informal, 30.34% formal; N = 9725 | China | N/A | AOR of early BF initiation (unemployment as base) |
| Chen et al. [53]; 2019; qualitative analysis | Mothers with children under 12 months who are living in one of the 12 randomly chosen county level regions (4 urban cities, 4 small and medium sized cities, 2 rural areas, 2 poor rural areas); Maternal education level: 6% primary school, 27% middle school, 20% high school, 47% ≥ college; Household income: 27% ≤ yuan 50,000, 35% yuan 50,000-100,000, 24% yuan 100,000-200,000, 14% ≥ yuan 200,000; N = 84 | China | Lactation breaks | Themes from interviews |

1. Employment benefits: Formal employment can provide maternal benefits ensured by law and regulations
   - Paid maternity leave: Mothers wish to extend paid maternity leave (min. 98 days) to be able to adhere to WHO BF recommendations, provision of longer unpaid breaks often difficult because of financial needs of families
Table 6 Summary of Publications Included in the Realist Analysis Following a Cross-Sectional Design. Realist Review on “How Do Breastfeeding Workplace Interventions Work?” (Continued)

CROSS-SECTIONAL DESIGN

- BF breaks: Mothers feel encouraged by BF breaks (1 h per workday for infant < 1 year) to continue BF after RTW. But if commute time is too long, mothers do not feel able to continue to BF after RTW despite provision of BF breaks
- Commute time: Length of commute time determines if formally employed mothers feel able to continue BF after RTW; for informally employed mothers, length of commute time determines if family support was accessible
- Workplace environment: Use of electric breast pumps as alternative for direct BF among working mothers, but concerns about physical lactation environment at the workplace
- Space for lactation: Social support as well as private and clean space as necessity to continue BF
- Equipment for pumping: limited equipment (possibilities to store BM, power outlets for breast pumps) at workplace as challenge to continue BF
- Labor intensity: Work schedule and workload influences frequency of BF or use of breast pump
- Flexibility of work schedule: Flexible work schedule as supporting factor; night shifts and irregular work schedules as reason for weaning
- Stress from work: BF with busy work schedule was tiring; high level of stress as a reason for perceived decrease of BM supply

| Lead Author; Publication Year | Study Population | Country | Intervention | Outcomes |
|------------------------------|-----------------|---------|--------------|----------|
| Scott et al. [31]; 2019      | Female adult employees (age ≥ 18 years) of the health care system who have been employed for ≥ 6 months and BF in the past 3 years prior to the study; Maternal age: 72.7% ≤ 35 years, 27.3% > 35 years; Maternal race: 76.8% White, 16.2% Black, 7.0% other; Maternal education level: 26.5% ≤ some college, 39.2% college degree, 34.3% graduate degree; N = 165 | USA | N/A | OR of BF duration
  - Organizational support: 1.05, 95% CI: 0.84–1.32, p = 0.65
  - Managerial support: 1.13, 95% CI: 0.88–1.44, p = 0.34
  - Co-worker support: 0.88, 95% CI: 0.67–1.14, p = 0.32

| Lead Author; Publication Year | Study Population | Country | Intervention | Outcomes |
|------------------------------|-----------------|---------|--------------|----------|
| Ibarra-Ortega et al. [56]; 2020 | Mothers working at institutions with more than 251 employees in Guadalajara, Mexico, with children aged between 6 and 35 months and who were working when BF was initiated; Maternal mean age: 34.9 ± 4.3 years (with lactation room) vs. 31.4 ± 4.7 years (no lactation room); Maternal education level: 21.1% ≤ high school, 78.9% ≥ college vs. 26.8% ≤ high school, 73.2% ≥ college; Maternal status: 17.1% single, 78.9% married, 4.0% others vs. 36.6% single, 58.5% married, 4.9% other; N = 158 | Mexico | Lactation room | OR of BF duration ≥ 6 months (lactation room vs. no lactation room): 3.15, 95% CI: 1.60–6.19, p = 0.001
  OR of BF duration ≥ 12 months (lactation room vs. no lactation room): 2.69, 95% CI: 1.23–5.86, p = 0.014
  OR of BF duration ≥ 26 months (lactation room vs. no lactation room): 2.53, 95% CI: 1.16–5.54, p = 0.022
  OR of EBF at 6 months (vs. partial BF) (lactation room vs. no lactation room): 2.98, 95% CI: 1.41–6.29, p = 0.006

| Lead Author; Publication Year | Study Population | Country | Intervention | Outcomes |
|------------------------------|-----------------|---------|--------------|----------|
| Kebede et al. [54]; 2020     | Permanently employed mothers with children aged 6–24 months working in governmental and/or nongovernmental organization in Dukem town; Mean maternal age: 27.1 ± 3.44 years; Maternal age: 16.6% 18–23 years, 60.4% 24–29 years, 23.0% ≥ 30 years; Maternal ethnicity: 90% Dromo, 1.0% Tigr, 6.7% Amara, 1.9% others; Maternal education level: 19.8% secondary, 44.1% diploma, 36.1% ≥ degree; Maternal status: 1.3% single, 92.7% married, 5.4% divorced, 0.6% widowed; Income: 1.3% ≤ Ethiopian Birr 500, 15.3% Ethiopian Birr 501–1000, 8.9% Ethiopian Birr 1001–1500, 16.9% Ethiopian Birr 1501–2000, 57.5% > Ethiopian Birr 2001; N = 313 | Ethiopia | - | NS difference in EBF and BF duration between mother who had access to lactation room but did not use lactation room and mothers without lactation room |
shows that the sole provision of time can be insufficient if the physical environment does not support breastfeeding.

Other contexts in which the sole implementation of breastfeeding interventions at the workplace are insufficient, are workplaces with a busy and/or inflexible work schedule, workplaces other than an office, and type of work such as shift work. Professions such as nurses or physicians have a work schedule that is often influenced by external factors which contributes to inconsistent scheduling. In such a context, the sole provisions of lactation breaks and lactation facilities are inefficient if mothers perceive their co-workers and supervisors as not supportive of them taking breastfeeding breaks [38].

Table 6 Summary of Publications Included in the Realist Analysis Following a Cross-Sectional Design. Realist Review on “How Do Breastfeeding Workplace Interventions Work?” (Continued)

| CROSS-SECTIONAL DESIGN |
|-------------------------|
| Country | Ethiopia |
| Intervention | Lactation break |
| Outcomes | OR of EBF discontinuation |
| | • No lactation break: 6.7, 95% CI: 3.0–14.5 |
| | • BF at workplace: 3.5, 95% CI: 1.7–7.2 |
| | • Pumping BM: 4.3, 95% CI: 1.7–11.0 |

95% CI 95% confidence interval, AOR adjusted odds ratio, BF breastfeeding, BM breastmilk, EBF exclusive breastfeeding, N/A not applicable, NS not significant, OR odds ratio, RTW return to work

Inflexible environments (e.g., fabric/production workplaces) and workplaces without a specific office as well as shift work are also contexts in which the sole provision of lactation breaks and lactation facilities are insufficient. Mothers working in a clean room (a room that is maintained free of contaminants) in two Taiwanese manufacturing companies had lower breastfeeding rates than their female colleagues having an office space in the same company [42–44]. Tsai and colleagues found that office workers and non-shift workers used the lactation breaks and facilities available to them more often than workers of the clean room and shift workers. To be able to use the offered lactation breaks, clean room workers needed to fully change from their clean room suits into normal clothes and then dress back into their clean room suits. This may have left less time to pump, thus, making the available lactation break times too short and less effective for breastfeeding. Chen et al. found that among women who were aware of lactation breaks and facilities, office workers had showed a higher likelihood for continued breastfeeding after returning to work than clean room workers indicating that in this context, the awareness mechanism was not mediating the breastfeeding outcomes. Given the rigid work schedule of clean room and shift workers, it is more likely that among them the intervention of breastfeeding breaks and facilities may not increase the time available for breastmilk expression.

Performance bonuses for manufacturing workers may inhibit the activation of support from co-workers, and thus, the activation of the time-releasing mechanism needed for breastfeeding and expressing breastmilk. Performance bonuses for most Taiwanese manufacturer workers are based on group productivity and individual performance [44], thus, breastfeeding mothers working in the clean room dependent on their co-workers to take over their duties while they are breastfeeding in order to keep their own performance bonuses and the ones of their co-workers, which may be unrealistic. Therefore, in order to increase breastfeeding rates among manufacturing and shift workers, workplace lactation interventions need to involve the network of co-workers to indirectly enable breastfeeding workers to use lactation breaks and facilities.

Table 7 Summary of Publications Included in the Realist Analysis Following a Posttest Design. Realist Review on “How Do Breastfeeding Workplace Interventions Work?”

| POSTTEST DESIGN |
|-------------------|
| Lead Author; Publication Year | Dodgson et al. [36]; 1997 |
| Study Population | Women who studied or worked at University of Minnesota and used the lactation room during the first 18 months of its existence; RTW: 36 yes (15 students, 15 staff, 6 faculty) – 10 no (7 students, 3 staff); N = 46 |
| Country | USA |
| Intervention | Lactation room |
| | Orientation package incl. Information about pump use, community lactation resources, collection and storage of BM |
| | Individual consultation and educational program Information and educational material related to BF for the lactation room and departments upon request |
| | Telephone BF consultations |
| Outcomes | Perceived impact on BF (1 being the least positive response, 7 being the most positive response; mean ± SD) |
| | • Increased use of BM instead of formula: 6.02 ± 1.57 |
| | • Increased length of BF duration: 5.27 ± 2.18 |
| | EBF rates among mothers who returned |
| | • 1 months: 91.4% |
| | • 3 months: 80.6% |
| | • 6 months: 47.2% |

BF breastfeeding, BM breastmilk, RTW return to work, SD standard deviation
Discussion

To our knowledge, this is the first realist review identifying potential mechanisms underlying the impact of workplace breastfeeding interventions as well as the effect of different contexts on the influence on breastfeeding outcomes of such interventions. Using a realist review approach, we were able to integrate findings from a plethora of study designs including qualitative studies.

An innovative aspect from our review is that we were able to develop a pragmatic context-mechanism-outcome (CMO) framework. This framework shows that contextual factors such as long distances between the workplace and the infant will hinder the influence of the intervention at improving breastfeeding outcomes among working mothers. Specifically, our CMO framework identified three mechanisms at work that need to

| Study Population | Female employees of Department of Pediatrics at Hunterdon Medical Center, New Jersey; Pretest group (N = 19): Mothers who took maternity leave between September 12, 1979 and May 27, 1981, before support program was implemented; Posttest group (N = 22): Mothers who returned to work between July 2, 1981 and January 7, 1983, after support program was implemented |
|-----------------------------------------------|
| Country | USA |
| Intervention | Lactation room; Electric breast pump (stored in the office of the Employee Health Service); Assistance by Employee Health Service (pump instruction, access to lactation room, information about BM storage and use at home); Refrigerator to store expressed BM; BF counseling |
| Outcomes | BF initiation: 16 out of 19 (pretest) vs. 22 out of 22 (posttest); Discontinuation of BF before RTW: 7 out of 16 (pretest) vs. 0 out of 22 (posttest), p < 0.003; Average EBF duration (weeks): 10.6 (pretest) vs. 12.1 (posttest), p < 0.003; Average total BF duration (months): 6.0 (pretest) vs. 11.7 (posttest), p < 0.003 |

| Study Population | Women working in factories in São Paulo (70% blue collar workers) who are in their third pregnancy trimester; Interview in third pregnancy trimester (N = 76); Re-interview after RTW (N = 69) |
|-----------------------------------------------|
| Country | Brazil |
| Intervention | Childcare at worksite; Lactation room for BM extraction and BM storage; Schedule flexibility; Not working in production line |
| Outcomes | Factors associated with longer BF duration: • Higher socioeconomic status; • Childcare at worksite; • Lactation room for BM extraction and BM storage; • Not working during weekend; • Not working in production line |

| Study Population | Employed mothers; Pretest group: N = 24; Posttest group: N = 33 |
|-----------------------------------------------|
| Country | Thailand |
| Intervention | BF education by nurse-midwives and/or lactation consultants in cooperation with nurses at the workplace; BF support by nurse-midwives and/or lactation consultants in cooperation with nurses at the workplace; Lactation room; BF support campaigns at the workplace |
| Outcomes | EBF rate at 6 months: 4.2% (pretest) vs. 36.4% (posttest), p = 0.004; Any BF rate at 6 months: 29.2% (pretest) vs. 57.6% (posttest), p = 0.033 |
be activated for an intervention to be effective: 1) the awareness of workers, supervisors and co-workers about the availability of entitlement to a given intervention, 2) changes in: perceived breastfeeding culture at the workplace, including manager/supervisor and co-workers support and adequate physical environments, and 3) having time to breastfeed or express breastmilk during work time.

Positive associations between workplace lactation support and interventions have been shown previously [11, 14–17, 19]. However, systematically understanding how such interventions work has been a major gap. Furthermore, examining how contexts mediate or moderate the influence of workplace breastfeeding interventions across different workforce groups had not been previously done, as far as we know. Our review is impactful because it provides this information at a time when an increasing number of women participate in the labor force [1, 2]. Our review indeed identified mechanisms that if properly taken into account when designing interventions may empower mothers to not have to decide between choosing the best nutrition for their infant or working, thus, helping close a major inequity gap affecting working women with infants globally.

While it is important to lessen breastfeeding inequalities between working and non-working mothers, it is as important to lessen these inequalities among working women. In the course of our analysis, we found that the studies represented a wide spectrum of maternal demographics including age, education level, race and ethnicity, income level, and marital status. Overall, higher breastfeeding rates and longer breastfeeding duration in the workplace were associated with higher maternal education [24, 25, 28, 31, 42–44, 54, 55], higher income levels [25, 28], being White [24–26] and being married or living with a partner [24, 28]. The included studies did not allow us to examine the underlying pathways that may have explained differences in implementation approaches as a result of differences in socioeconomic and demographic contexts because awareness and/or uptake of the interventions were seldomly examined as a function of the afore mention characteristics. Therefore, future research is needed to elucidate how best to tailor work-based breastfeeding interventions to different contexts.

The available data did also not allow us to determine underlying pathways which may explain differences in breastfeeding outcomes of work-based intervention as a function of type of employment (full-time vs. part-time employment). This is because the study authors did not examine awareness and/or uptake of the intervention as a function of the employment status which would be needed to be able to determine differences in awareness and/or uptake of the intervention among women with different employment status as pathway for the differences seen in breastfeeding outcomes among women with different employment status. One study showed a significant association between part-time employment and higher breastfeeding rates at 6 months while two other studies did not find significant associations [34, 39]. Possible explanations of these inconsistent findings are the heterogeneous use of the term “part-time” and

| Study Population | Outcomes | Country | Intervention | Country | Intervention | Outcomes |
|------------------|----------|---------|--------------|---------|--------------|----------|
| Women working at a public university with access to the institution’s childcare program; Focus group discussion; 15 women EBF their babies, 15 women whose babies were already being fed with other food besides BM; of these 30 women, 20 agreed to participate in 2 focus group discussions (10 women per focus group discussion) | Free childcare at the workplace may facilitate EBF once women return to work | Brazil | Childcare at workplace | USA | N/A | Positive association for BF duration: Maternal self-efficacy for BF and BF duration, p = 0.01 Maternal self-efficacy for combining work and BF and BF duration, p = 0.00 Maternal comfort to ask for lactation accommodation, p = 0.00 Maternal perception of supportive co-worker, p = 0.00 Maternal comfort to take lactation breaks, p = 0.00 Maternal comfort to adjust break schedule to meet pumping needs, p = 0.00 Negative association for BF duration: Maternal perception that number of hours worked made it difficult to combine BF and working, p = 0.00 Maternal perception of insecure job, p = 0.04 NS association for BF duration: Maternal perception of supportive manager, p = 0.75 |

BF breastfeeding, BM breastmilk, EBF exclusive breastfeeding, N/A not applicable, NS not significant, RTW return to work

**Table 9** Summary of Publications Included in the Realist Analysis Following a Qualitative Analysis. Realist Review on "How Do Breastfeeding Workplace Interventions Work?"
the heterogenous group of part-time working mothers. For example, it is clear that the needs for breastfeeding support of a mother working 8 h a week are likely to be different from the needs of a mother working 40 h a week. However, it is unclear how the needs of a mother working 40 h a week would compare with the needs of a mother working 34 h a week, either as a four-day workweek or distributed across all weekdays. Moving forward, instead of using unclear terms like “part-time” employment, future research should consider evaluating workplace breastfeeding interventions based on actual hours worked per day and days worked per week.

While this realist review integrated evidence from a plethora of study designs allowing for the examination of how workplace breastfeeding interventions work across various contexts and uncovering potential pathways for impact, it is not without limitations. Firstly, the review did not include studies that were solely focusing on maternity leave benefits. Rather, it focused on lactation interventions for mothers returning to the workplace. We made this decision because previous work has documented the positive impact of extended duration of maternity leave on breastfeeding outcomes \[59, 60\] and maternity leave policies are beyond the sole domain of the employers. Secondly, in order to bring focus to the review, we limited the search to studies reporting on

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Table 10 Intervention Types and Categories. Realist Review on “How Do Breastfeeding Workplace Interventions Work?”

| Intervention type                  | Intervention category                        |
|-----------------------------------|---------------------------------------------|
| Provision of equipment/facility   | Lactation room                              |
|                                   | Electric breast pump                        |
|                                   | Refrigerator                                |
|                                   | Day-care center                             |
| Provision of time                 | Lactation break times                       |
|                                   | Allowance of flexible break times/work schedule |
| Education                         | Breast pump instruction                     |
|                                   | Prenatal breastfeeding education            |
|                                   | Breastfeeding education, time not specified |
|                                   | Lactation counseling                        |
|                                   | Return to workplace counseling              |
|                                   | Expectant father education                  |
|                                   | Provision of breastfeeding information (written or verbally) |
| Human resource policy and communication | Workplace lactation policy                 |
|                                   | Communication strategy                      |

Fig. 2 Context-Mechanism-Outcome Framework of Breastfeeding Interventions at the Workplace. Realist Review on “How Do Breastfeeding Workplace Interventions Work?”
breastfeeding outcomes. This limitation omitted publications reporting on other outcomes of workplace breastfeeding interventions such as job satisfaction or health costs for employers, employees and/or society. And lastly, as recommended for realist reviews, we used a purposive rather than a comprehensive screening strategy. Thus, it is possible that a relevant paper could have been available in the databases we searched, but was not retrieved by our queries, as we screened only those papers where the workplace context was explicit in either the title and author keywords or subject headings. To mitigate this risk, we searched in multiple subject-indexed databases, on the reasoning that a paper which was poorly indexed in Medline may have been better indexed in CINAHL or Global Health.

Because of time limitations, we did not conduct grey literature searches as well as citation chaining. It is possible that these omissions led to the introduction of biases. Nevertheless, we think that this is unlikely because the vast majority of grey literature about workplace breastfeeding interventions are technical guidelines on how to implement specific interventions such as lactation rooms [61], and do not report on breastfeeding outcomes, thus would not have passed the eligibility criteria for inclusion of the present review. Since we searched a plethora of databases, we are confident that our search picked up the vast majority of eligible publication, thus, we estimate the risk of bias introduction due to the missing citation chaining as minimal.

Our review strongly calls for more mixed methods work-based breastfeeding intervention research in low- and middle-income countries, that also includes the very large number of women working in the informal economy. Of the 37 included studies, only one study was conducted in a low-income country [54] as defined by the World Bank [62]. This is unfortunate, as out of the approximately 7.7 billion people in the world in 2019, 6.5 billion people lived in low- and middle-income countries, and 670 millions lived in low-income countries [63]. None of the included studies of this review focused solely on informal employment and the majority included only formally employed women. While formally employed mothers can be protected by laws and regulations, such as mandated maternity leave, informally employed women may need to depend on other mechanisms that support their informed decisions about infant feeding [53]. Therefore, there is a profound inequity in the selection of settings where the work-based breastfeeding research has been conducted, as well as the type of employment included in those studies (formal vs. informal economy). This is unacceptable given the very high proportion of women employed in the informal sector in low- and middle-income countries [64]. How the policy design and program implementation mechanisms need to differ for delivering effective work-related breastfeeding interventions targeting women employed in the informal vs. the formal economy, still need to be elucidated using qualitative and quantitative implementation research approaches.

Conclusion
Workplace breastfeeding interventions work through raising awareness among employees, supervisors and co-workers, changes in workplace breastfeeding culture, including knowledge, attitudes, and support from managers/supervisors and co-workers, and improvements in the physical environment, alongside with the time release needed by working mothers while at work for breastfeeding or extracting breastmilk. In order to better address breastfeeding inequities affecting working mothers, workplace breastfeeding interventions need to be tailored according to several contextual factors including socioeconomic and demographic characteristics of the mothers or end users. The evidence of this review clearly shows that workplace breastfeeding interventions cannot follow a one-size-fits-all approach, but rather should be tailored for the contextual factors underlying the different working conditions for mothers globally.

Supplementary Information
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Authors’ contributions
KL and RPE designed the study. All authors contributed to the study protocol with their valuable feedback. KN developed the search strategy with input from KL and RPE and conducted the search of the bibliographic databases. KL, VT and RPE screened the search results and conducted the analysis. KL and VT drafted the first version of the manuscript. All authors gave valuable input to the drafted manuscript, read and approved the final manuscript.

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