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Opportunities to Effectively Promote Breastfeeding in German Workplaces:
A Systematic Review

Master Thesis

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Abstract

Background: Even though breastfeeding has several advantages, the prevalence in Germany is low and far beneath recommendations. One field that has an impact on breastfeeding is maternal employment. The aim of this thesis was, to identify interventions, which can be introduced by employers in Germany to effectively promote breastfeeding among employed mothers.

Methods: A systematic review was conducted following the guidance of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). It focused on employed women of all ages and professions returning (or having recently returned) to work after giving birth, being or having recently been exposed to interventions or workplace characteristics promoting breastfeeding in the workplace. Self-employed women, pupils, or students in respective settings not constituting a workplace were excluded. All types of workplace-level interventions within the sphere of influence of the employer focusing on breastfeeding support are of interest, whereas any direct breastfeeding indicator focusing on the duration of breastfeeding represents a possible outcome variable. All types of published primary quantitative studies in English and German, published between 2013 and 2023 in high-income countries, for which free full text was available were included. The search was performed in the databases MEDLINE, EMBASE, CINAHL, Web of Science, and CENTRAL, accompanied by an additional search in Google Scholar. Methodological quality and risk of bias of the included studies are assessed using the critical appraisal checklists by the Joanna Briggs Institute (JBI). Synthesis of the result is conducted narratively by forming subgroups. In the discussion, the results are transferred to Germany and targeted application opportunities are outlined.

Results: Data was extracted from 13 studies, including a number of 9,767 participants, mostly of average to higher socio-economic status. The studies were conducted primarily in the USA (n=7), but also in China (n=2), Japan (n=1), Spain (n=1), Australia (n=1), and the United Kingdom (n=1). The most common intervention approaches were the provision of break time for breastfeeding (n=10), designated space for breastfeeding (n=7), support from supervisors and coworkers (n=6), and a combination of different interventions (n=5), also including such related to information and education. The impact of a written workplace policy (n=3) and single utility items (n=2) were studied less often.

Discussion: Available evidence suggests, that workplace interventions might help to increase the duration of breastfeeding. This can be concluded with greater certainty when several interventions are applied in combination. Among the mentioned individual approaches, the best evidence is found for the provision of time, space, and supervisor or coworker support. In Germany, the greatest need for action is seen in the latter approach,

followed by breastfeeding space-related measures. In comparison, Germany is best positioned in the field of break times for breastfeeding, but further improvements are still recommendable. Mainly observational studies are included in this review, showing a high risk of bias, which contributed to rating certainty of the body of evidence as low to very low. No conclusions can be drawn about effects and better-quality research is needed.

Keywords: Breastfeeding, Lactation, Workplace, Occupational Health Management, Return-to-work, Human Resources Measures

Table of Contents

List of Tables	V
List of Figures	VI
List of Abbreviations	VII
1 Introduction	1
2 Background.....	4
2.1 Definition of Breastfeeding.....	4
2.2 Benefits of Breastfeeding.....	5
2.3 Breastfeeding in Germany	10
2.3.1 Recommendations.....	10
2.3.2 Prevalence	10
2.3.3 Determinants	14
2.4 Work-related Conditions for Mothers in Germany	19
2.4.1 Labor Market Participation.....	19
2.4.2 Legal Regulations for Breastfeeding Mothers	21
2.5 Contribution to the Sustainable Development Goals	25
2.6 Current State of Research	26
3 Methodology	29
3.1 Study Design	29
3.2 Eligibility Criteria	29
3.3 Information Sources.....	32
3.4 Search Strategy.....	32
3.5 Selection Process.....	34
3.6 Data Extraction	35
3.7 Critical Appraisal.....	35
3.8 Data Synthesis	37
3.9 Certainty Assessment.....	38
4 Results.....	40
4.1 Study Selection.....	40

4.2	Study Characteristics.....	41
4.2.1	Determinants of Breastfeeding	41
4.2.2	Variables and Statistical Methods.....	46
4.3	Critical Appraisal.....	48
4.4	Certainty Assessment.....	54
4.5	Narrative Synthesis.....	55
4.5.1	Break Time	55
4.5.2	Breastfeeding Space	59
4.5.3	Single Utility Items	62
4.5.4	Supervisor and Coworker support.....	63
4.5.5	Workplace Policy	67
4.5.6	Combined Measures.....	68
5	Discussion.....	72
5.1	Findings of the Systematic Review	72
5.2	Implications for Workplaces in Germany.....	75
5.3	Limitations	85
5.4	Implications for Future Research	87
6	Conclusion	89
	References	VIII
	Declaration of Independent Work.....	XX
	Appendix.....	XXI

List of Tables

Table 1: Interventions investigated by published reviews	26
Table 2: Eligibility criteria according to PICO-format	29
Table 3: Categorization of studies according to estimated socio-economic status of study samples.....	43
Table 4: Heterogeneity of included studies in terms of statistical methods and outcome variables used	47
Table 5: Summary of independent variables reported in included studies	48
Table 6: Studies investigating the association of break time on exclusive breastfeeding outcomes	55
Table 7: Studies investigating the association of break time on outcomes related to any breastfeeding	57
Table 8: Studies investigating the association of space on outcomes related to exclusive breastfeeding	59
Table 9: Studies investigating the association of space on outcomes related to any breastfeeding.....	61
Table 10: Studies investigating the association of single utility items on outcomes related to exclusive and any breastfeeding	62
Table 11: Studies investigating the association of supervisor and coworker support on outcomes related to exclusive breastfeeding	63
Table 12: Studies investigating the association of supervisor and coworker support on outcomes related to any breastfeeding	65
Table 13: Studies investigating the association of a workplace policy on outcomes related to exclusive and any breastfeeding	67
Table 14: Studies investigating the association of combined measures on outcomes related to exclusive and exclusive breastfeeding	68
Table 15: Studies investigating the association of combined measures on outcomes related to exclusive and any breastfeeding	69

List of Figures

Figure 1: Info box - definition of "breastfeeding"	4
Figure 2: Definition of breastfeeding status	5
Figure 3: Benefits of breastfeeding for infants	5
Figure 4: Benefits of breastfeeding for mothers.....	7
Figure 5: Breastfeeding prevalence in Germany	12
Figure 6: Breastfeeding prevalence in Germany and globally	13
Figure 7: Different levels with related factors influencing breastfeeding behavior.....	14
Figure 8: Reasons for weaning by the duration of any breastfeeding in Germany, specified in percent.....	18
Figure 9: Specifications of ASR A4.2 - Break and on-call rooms - Facilities for pregnant women and nursing mothers.....	23
Figure 10: Sustainable Development Goals supported by breastfeeding promotion at the workplace	25
Figure 11: Level of evidence for different study designs.....	31
Figure 12: Basic search strategy - search terms combined by boolean operators.....	33
Figure 13: Search strategy applied to Google Scholar	34
Figure 14: Levels of the certainty of a body of evidence in the GRADE approach.....	38
Figure 15: Flow diagram of the study selection process.....	41
Figure 16: Critical appraisal of cross-sectional studies.....	49
Figure 17: Critical appraisal of quasi-experimental studies	52
Figure 18: Critical appraisal of case-control studies	53
Figure 19: Level of certainty of evidence of approaches to promote breastfeeding among working mothers in high-income countries	72
Figure 20: Components to approach in order to achieve optimal breastfeeding promotion in the workplace	75
Figure 21: Example of a basic breastfeeding room	78

List of Abbreviations

ASR	Technische Regeln für Arbeitsstätten (engl.: technical rules for work-places)
BEEG	Bundeselterngeld- und Elternzeitgesetz (engl.: Federal Parental Allowance and Parental Leave Act)
BfR	Bundesinstitut für Risikobewertung (engl.: Federal Institute for Risk Assessment)
BMEL	Bundesministerium für Ernährung und Landwirtschaft (engl.: Federal Ministry of Food and Agriculture)
BZgA	Bundeszentrale für gesundheitliche Aufklärung (engl.: Federal Centre for Health Education)
CDC	Center for Disease Control and Prevention
GRADE	Grades of Recommendation, Assessment, Development and Evaluation
JBI	Joanna Briggs Institute
KiGGS	Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland (engl.: Study on the health of children and adolescents in Germany)
MeSH	Medical Subject Headings
MuSchG	Mutterschutzgesetz (engl.: Maternity Protection Act)
NSK	Nationale Stillkommission (engl.: National Breastfeeding Commission)
OR	Odds ratio
PICO	Population, Intervention, Comparison or Control, Outcome (acronym)
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analysis
RKI	Robert Koch Institut
SDGs	Sustainable Development Goals
UNICEF	United Nations International Children's Emergency Fund
WBSS	Workplace breastfeeding support scale
WHO	World Health Organization

1 Introduction

There is broad consensus on the national, European, and global level, that breast milk is the ideal and natural form of nutrition for the infant (Federal Centre for Health Education (BZgA), 2022; Center for Disease Control and Prevention (CDC), 2022; Koletzko et al., 2013, p. 239; World Health Organization (WHO), 2023). It has several short- and long-term advantages for the mother¹ and the child (BZgA, 2022; von der Lippe et al., 2014, p. 849). Inadequate breastfeeding is responsible for 16% of child deaths worldwide each year (WHO, 2020). At the same time, the scaling up of breastfeeding could prevent an estimated 823,000 child deaths of children under five years old globally each year (Victora et al., 2016, pp. 476 & 485), which emphasizes the strong health-promoting effect of breastfeeding. It affects not only child growth but also shields them from infectious diseases, boosts brain and psychological development, and guarantees children a safe and nutritious food source (BZgA, 2022; Rouw et al., 2018, pp. 945–949; United Nations International Children’s Emergency Fund (UNICEF), 2023), while simultaneously it decreases the number of hospital admissions (Victora et al., 2016, p. 479).

The mother benefits of e.g. a decreased risk for non-communicable diseases, like some sort of cancer or diabetes (Victora et al., 2016, pp. 476, 479, 480 & 485). For example, there is evidence, that breastfeeding can prevent an estimated 20,000 deaths of breast cancer every year (Victora et al., 2016, pp. 476 & 485). Further, breastfeeding realizes potential benefits for the health care system and the economy (Rollins et al., 2016, pp. 497–501). For example, in high-income countries, the estimated percentage loss in gross national income from cognitive deficits associated with alternative infant feeding practices compared with every infant breastfeeding until at least 6 months of age accounts for 231.4 billion Euro of estimated loss (Rollins et al., 2016, p. 499). While the promotion of breastfeeding might also produce investments, it might be more costly to not invest in breastfeeding promotion (Rollins et al., 2016, p. 491). Furthermore, breast milk is a natural, renewable food which contributes to environmental sustainability and climate protection (Rollins et al., 2016, pp. 497–501).

¹ In general, for this thesis, it should be adopted what was formulated by Smith et al. (Dr. E. Smith et al., 2023, p. 2): “This document uses the word ‘mother’ to describe parents who are breastfeeding. We acknowledge that there are breastfeeding parents who may have a gender identity other than female and may use terms other than ‘mother’ to describe themselves. We also know that some parents may prefer ‘chest feeding’ to ‘breastfeeding’. We are clear that all parents should be treated with dignity and respect when accessing support.”

Against this background, WHO and UNICEF (2021, p. 3) even set the global 2030 target that, among other things, 80% of children are still breastfed at one year of age and 60% are still breastfed at two years of age. As high-income countries have a lower prevalence of breastfeeding compared to low-income countries (Victora et al., 2016, p. 477), it seems reasonable to focus on a high-income country such as Germany to promote breastfeeding. Although breastfeeding promotion can be seen as primary prevention for many morbidities, breastfeeding prevalence is still far away from recommendations and from mentioned global targets in Germany, especially with regard to breastfeeding duration (Federal Institute for Risk Assessment (BfR), 2022; A.-K. Brettschneider et al., 2018, pp. 921 & 924; WHO, 2003). The country is rated as moderately breastfeeding-friendly and compares poorly on the international level in terms of prevalence and due to multifactorial deficits in the breastfeeding promotion landscape, with one field of action being in the workplace setting (Federal Ministry of Food and Agriculture (BMEL), 2021a, p. 1; A.-K. Brettschneider et al., 2018, pp. 921 & 924; Rosin, 2018, p. 50; WHO & UNICEF, 2021, pp. 3 & 4).

Despite existing legal provisions for the protection of breastfeeding at the workplace by the Maternity Protection Act (German: Mutterschutzgesetz; MuSchG), women still report that they are weaning because of re-entering the workforce (A.-K. Brettschneider et al., 2018, p. 923). Breastfeeding is uncommon and largely not accepted by German society in this setting, whereas 43% of German women state avoiding to breastfeed at the workplace (S. Lücke et al., 2022, p. 1191). This is, although companies could even benefit from breastfeeding promotion in their company, e.g. through reduced sick days, increased staff morale and loyalty, earlier re-entry of mothers, or a lower fluctuation rate, which can even positively affect the company's profit (Haviland et al., 2015; National Health Service UK, 2021; PAHO/WHO, 2021; UNICEF, 2020, p. 7). At the same time, the need to reconcile family and career is growing, as women tend to return to work earlier after giving birth, which even seems increasingly politically intended (Geis-Thöne, 2017). This highlights the need to adapt workplace conditions to breastfeeding mothers' and children's needs to reduce inequities in terms of health and employment choices and to counteract gender discrimination and financial injustice. Incidentally, approaching the topic has multifactorial positive effects on a variety of areas, illustrated by its contribution to the fulfillment of eight sustainable development goals (SDGs).

Along with the relevance of the topic, a research gap was identified with regard to the effectiveness of interventions to promote breastfeeding in companies in the context of Germany. No studies have been found that first identify and then compare effective measures on the (inter)national level with the framework conditions in Germany, to check applicability. This is where this research work intends to start, setting the focus on the sphere of influence

of the workplace, resp. the employer. Against this background, the following research question emerges:

Which interventions can employers in Germany introduce in the workplace to effectively promote breastfeeding among employed mothers?

By conduction of a systematic review, effective interventions² to promote breastfeeding in the workplace in high-income countries in general shall be identified. Thereafter, for those interventions that appear promising, the applicability to Germany is discussed. For this purpose, it is determined which policies and practical conditions are already in place and which interventions would conclusively be appropriate support options to be conducted by employers or corresponding occupational health professionals in Germany.

The results of the thesis can thus primarily benefit employers, breastfeeding working mothers with their children, and indirectly also society. Nevertheless, indirectly the results could also be useful for policymakers or other actors like the National Breastfeeding Commission (German: Nationale Stillkommission; NSK) and e.g. represent an evidence-based foundation for the development of information or educational purposes. In addition, a basis shall be created for identifying the areas in which there is a need for research.

² It should be noted that the breastfeeding promotion interventions outlined should indeed lead to an increase in breastfeeding rates, as this makes sense for health and other mentioned reasons. However, this can also lead to increased social pressure to breastfeed, which is caused, among other things, by the connotation of breastfeeding with the terms "normal" or "natural" (Freudenschuß, 2012, p. 138). This is not the aim of this paper. Rather, the aim is to improve the possibility for women to make informed and self-determined decisions.

2 Background

In the following, the main definitions are provided and the importance of breastfeeding in industrialized countries such as Germany is described in more detail. The current breastfeeding behavior is set in relation to existing recommendations. Further, determinants of breastfeeding and their state-of-the-art in Germany are briefly mentioned, while the conditions related to the workplace in Germany will be discussed in particular, comprising for example legal regulations, current developments, or statistical findings. Finally, the relevance of the topic is further supported with reference to the contribution to eight sustainable development goals, and by distinguishing it from existing research.

2.1 Definition of Breastfeeding

For an unambiguous understanding of the work, fundamental terminology shall be provided. This includes the definition by the National Cancer Institute (2011) of the term “breastfeeding” and “nursing”, which are used interchangeably as evident from Figure 1.

Definition “breastfeeding”:

“The act of feeding breast milk to an infant. Babies can be fed directly from the mother’s breast, or breast milk can be pumped and then fed to the baby from the bottle. (...) Also called nursing.” (National Cancer Institute, 2011)

Figure 1: Info box - definition of "breastfeeding", own figure

With regard to this definition, if in this thesis a difference in how breast milk is fed is made, it becomes apparent from the context of what is written. Otherwise, the term is used as defined.

Additionally, breastfeeding status is differentiated into three categories as defined by the Robert Koch Institute (RKI) (2020). “Exclusive breastfeeding” means, the infant does not receive any other liquids or complementary foods other than breastmilk. While “full breastfeeding” includes exclusive breastfeeding and means, that additional liquids such as water and tea can be given. “Any breastfeeding” includes exclusive and full breastfeeding and comprises the feeding with nutritious liquids (especially formula) or complementary foods (RKI, 2020, p.1). Figure 2 serves as an illustration.

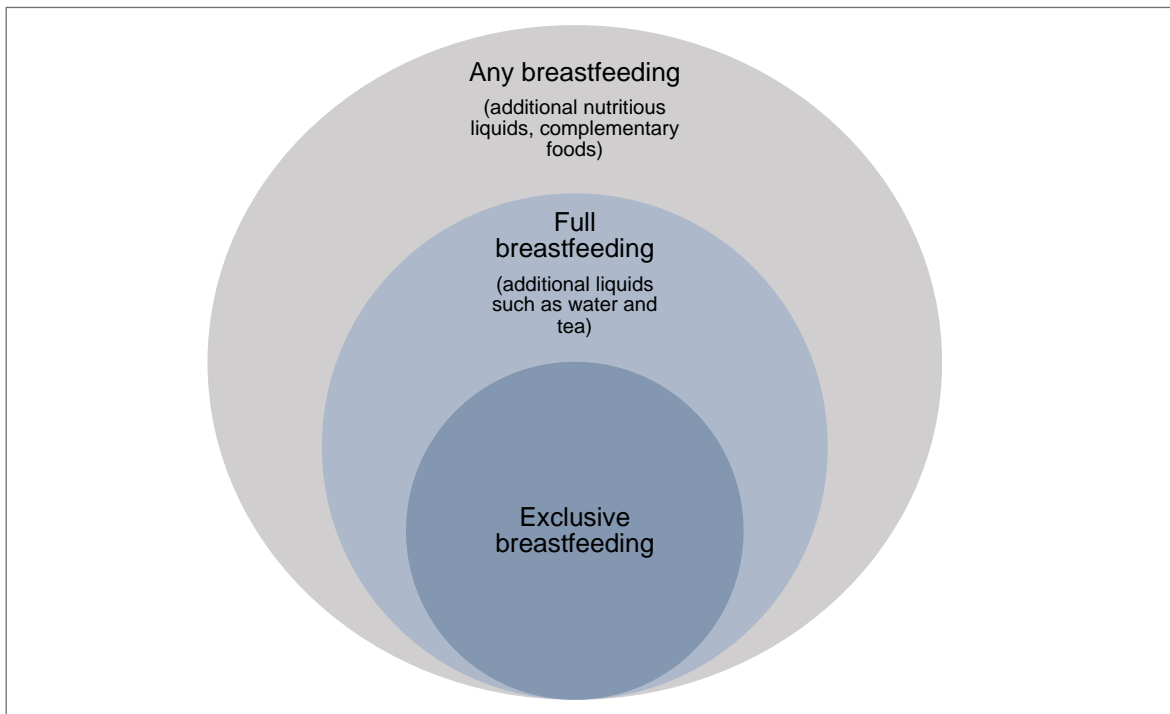


Figure 2: Definition of breastfeeding status, own figure based on Brettschneider et al., 2016, p. 18

2.2 Benefits of Breastfeeding

For the Child

Within the first two years of life, breastfeeding is one of the most effective ways to ensure child health and survival (UNICEF, 2023; WHO, 2023). The short- and long-term benefits of breastfed infants outlined in the following, are summarized in Figure 3. There is no claim to completeness.

<p>Short-term:</p> <ul style="list-style-type: none">▪ Reduces risk for several common childhood infections, e.g.<ul style="list-style-type: none">▪ Severe lower respiratory disease▪ Acute otitis media (ear infections)▪ Gastrointestinal infections (diarrhea/ vomiting)▪ Reduces the risk of sudden infant death syndrome (SIDS)▪ Reduces the risk of necrotizing enterocolitis for preterm infants <p>Long-term:</p> <ul style="list-style-type: none">▪ Prevention of overweight or obesity▪ Prevention of diabetes mellitus type II▪ Prevention of dental malocclusions▪ Promotion of brain and psychological development▪ Promotion of mother-child bond (also short-term)

Figure 3: Benefits of breastfeeding for infants, own figure

Breast milk is uniquely adapted to the infants needs and contains a variety of immunological substances and epigenetic factors that cannot be replicated by industry (European Institute for Breastfeeding and Lactation, 2022b). In the short term, the antibodies contained help to provide relative protection against numerous common childhood infections, including lower respiratory tract infection, middle ear infection, and gastrointestinal infection, even in

developed countries (Ip et al., 2009; Kersting et al., 2020, p. V7; RKI, 2020; Rouw et al., 2018, p. 946). Victora et al. (2016, p. 479) stress, that the protection against admission to a hospital due to these diseases is large (Victora et al., 2016, p. 479). Additionally, breastfeeding plays a significant role in the prevention of sudden infant death syndrome (SIDS), with almost halving of the risk if infants were breastfed for a minimum of two months, whereas it did not matter whether the child was exclusively or partially breastfed; but as the duration of breastfeeding increases, these protective benefits also do (Thompson et al., 2017, p. 16). Furthermore, there is evidence, that breastfeeding is associated with a 58% reduction in necrotizing enterocolitis, a disorder with high case-fatality in all settings for pre-term infants (Victora et al., 2016, p. 479). These indicators stress, that breastfeeding might also protect against deaths in high-income countries (Victora et al., 2016, p. 479).

When a child is breastfed, it has health implications far beyond the actual period of breastfeeding (Rouw et al., 2018, p. 947), which makes breastfeeding highly relevant in terms of public health matters. In the long term, existing evidence leads to the assumption that breastfeeding can lower the risk for the development of certain non-communicable or chronic diseases, such as obesity and type II diabetes mellitus (Horta et al., 2015, p. 36; Victora et al., 2016, p. 480; WHO, 2022b). For example, a meta-analysis including studies that are mostly from high-income settings shows, that longer periods of breastfeeding are associated with a 26% reduction in the odds of overweight or obesity in later life (Victora et al., 2016, p. 480). Children who are breastfed for longer periods not only have lower morbidity and mortality, but moreover, there are indications that they have fewer dental malocclusions and that breastfeeding might positively affect brain and psychological development, while this inequality should persist until later in life (Black et al., 2017, p. 14; Krol & Grossmann, 2018, p. 981). As breastfeeding can enhance feelings of affection between mother and child, breastfeeding promotes bonding and therefore supports the emotional mother-baby relationship (Kersting et al., 2020, p. V7; RKI, 2020, p. 1; WHO, 2009, p. 12).

For the Mother

To provide an overview of the short- and long-term benefits of breastfeeding for mothers, a summary is provided in Figure 4 without purporting to be exhaustive.



Figure 4: Benefits of breastfeeding for mothers, own figure

In the short term, the rise in the hormonal oxytocin concentration in the mother's blood due to breastfeeding leads to accelerated involution of the uterus, which reduces blood loss and prevents infections of the endometrium (Abou-Dakn, 2018, p. 986; Kersting et al., 2020, p. V7; WHO, 2009, p. 12). The oxytocin concentration also has a positive effect on the stress level of the mother, as several studies demonstrate that breastfeeding mothers showed a greater emphasis on the parasympathetic response: they exhibited a lower heart rate, lower blood pressure, and a lowering of cortisol levels (Abou-Dakn, 2018, p. 986; WHO, 2009, p. 12). These effects were particularly evident in women who were exclusively breastfeeding (Abou-Dakn, 2018, p. 986). According to the WHO (2009), besides the hormone oxytocin, also prolactin is involved in breastfeeding. Of this hormone, more is produced at night, while it makes the mother feel more relaxed and sleepier, having the effect that she usually rests well even if she breastfeeds at night (WHO, 2009, p. 11). Further, there are indications that breastfeeding decreases depressive symptoms after birth while early breastfeeding cessation may contribute to the presence of postpartum depression (Dias & Figueiredo, 2015, pp. 151 & 152). Furthermore, the postpartum anovulatory phase, during which ovulation does not occur, is prolonged in women by breastfeeding, which can improve birth spacing (Sridhar & Salcedo, 2017, pp. 1 & 2). In addition, it is emphasized that the benefits also include practical aspects, such as the milk always having the right temperature, being hygienically available at each location and at every time in the perfect quality and quantity for the baby as there can be no overfeeding when breastfeeding and being free of charge (BZgA, 2022; Leung & Sauve, 2005, p. 1010; Prell & Koletzko, 2016, p. 436; UNICEF, 2020, p. 9).

In the long term, breastfeeding is associated with a lower risk for breast cancer, particularly when breastfeeding over longer durations (Chowdhury et al., 2015, p. 105; Zhou et al., 2015, p. 175). There is evidence, that the risk of developing this type of cancer is reduced by about 26% among women who cumulatively breastfeed for more than twelve months (Chowdhury et al., 2015, p. 103). This is especially relevant in developed countries, where a lack of or short breastfeeding duration of women is typical, leading to a major contribution to a high incidence of breast cancer in these countries (Victora et al., 2016, p. 476). Also for the incidence of ovarian cancer, it was found that breastfeeding for at least twelve months leads to a significant reduction of this sort of cancer of about 35% (Chowdhury et al., 2015, p. 104). With regard to endometrial cancer, a meta-analysis showed a corresponding reducing effect of breastfeeding in dependence on the duration of breastfeeding (Zhan et al., 2015, p. 38398). Additionally, a protective effect of breastfeeding against cardiovascular diseases in later life was identified (Countouris et al., 2016, p. 2; Zachou et al., 2019, p. 73). It seems to protect against some related risk factors, such as hypertension, metabolic syndrome, and also diabetes (Zachou et al., 2019, p. 73). Also here, breastfeeding duration is found to be independently associated with a lower incidence of diabetes (Gunderson et al., 2018, p. 328). It is suggested, that a longer duration of breastfeeding reduces the risk of development of type II diabetes mellitus by 32%, while there was a 9% reduction in relative risk for each twelve-month increase in lifetime duration of breastfeeding (Chowdhury et al., 2015, p. 105).

Economic Benefits

With regard to described health implications of breastfeeding, reducing mortality and morbidity; and with regard to the improved educational potential of children, resulting in increased earnings as adults (Victora et al., 2016, pp. 484, 487 & 488), it can already be suggested, that breastfeeding has a positive impact on the economy in terms of income and significant savings to health services. Rollins et al. (2016) confirm the economic benefits of breastfeeding by means of a model calculation, pointing out the estimated economic losses of not breastfeeding (Rollins et al., 2016, p. 497-501). The result is that in high-income countries the estimated percentage loss in gross national income from cognitive deficits associated with alternative infant feeding practices compared with every infant breastfeeding until at least 6 months of age is 0.53%, which is \$231.4 billion³ or 231.4 billion Euro⁴ of estimated loss (Rollins et al., 2016, p. 499). It is stated, that the promotion of breastfeeding might also produce investments, but that it might be more costly to not invest in breastfeeding promotion (Rollins et al., 2016, p. 491). Other references confirm the economic benefits

³ In 2012 USD

⁴ In 2012

of breastfeeding (Bartick & Reinhold, 2010; Clark et al., 2020; Renfrew et al., 2012; J. P. Smith & Harvey, 2011; Weimer, 2001). Even if Germany lacks systematic studies on the economic aspects of breastfeeding, a conservative calculation is for example provided by Rouw et al. (2015, pp. 2 & 3), showing annual savings of about 11 million Euro, based on the incidence and costs of otitis media and the prevention of 25% of cases through breastfeeding. This implies, that the benefits of breastfeeding go beyond those of mother and child, but also apply to the entire population.

Benefits for the Environment and Climate

Breast milk is described as “a natural, renewable food that is environmentally safe and produced and delivered to the consumer without pollution, unnecessary packaging, or waste” (Rollins et al., 2016, p. 499). Breast milk substitutes, on the other hand, leave an environmental footprint, requiring energy for manufacturing, water, dairy farming, materials for packaging, fuel for transportation, and detergents for daily preparation and use (Rollins et al., 2016, p. 499; Dr. E. Smith et al., 2023, p. 9). So, the promotion of breastfeeding contributes to environmental sustainability and climate protection. Bier et al. (2023) even state that if global breastfeeding were to follow WHO recommendations, the impact on the climate would be greater than if global production were to switch to renewable energy.

Benefits for Companies

In addition to this, supporting breastfeeding in the workplace has significant human and economic benefits for companies. This includes reduced absence due to sickness or doctors' appointments (UNICEF, 2020, p. 7). It increases staff morale and loyalty, it might make women re-enter their workplace sooner after having a baby, or lead to a lower rate of fluctuation of personnel; this leads to lower recruitment and training costs and represents an extra incentive that can be offered to potential employees and finally, all this might have positive effects on the profitability of the company (Haviland et al., 2015; National Health Service UK, 2021; PAHO/WHO, 2021; UNICEF, 2020, p. 7).

Conclusively, evidence shows that the decision to not breastfeed a child has significant short- but also long-term effects, while breastfeeding is a health behavior that has a multi-layered, differential impact on the two involved individuals: the mother and the child (Victora et al., 2016, p. 485). The duration of breastfeeding and in part also the exclusivity seems to be meaningful in this respect. However, each breastfeeding seems to be valuable. Yet, the advantages go beyond health aspects. Contribution to human capital development, environmental sustainability, and climate protection are matters that affect society as a whole. This highlights the strong potential of breastfeeding as a health-promoting intervention, posing benefits for various target groups in different ways. This includes the child and mother, as well as companies and the general population in different settings and countries.

2.3 Breastfeeding in Germany

2.3.1 Recommendations

Beyond the scientific basis regarding the benefits of breastfeeding, different relevant stakeholders such as the German Society for Nutrition, the NSK, the European Society for Pediatric Gastroenterology, Hepatology and Nutrition, and WHO and UNICEF unambiguously recommend that breastfeeding should be fully encouraged and that all breastfeeding is beneficial and helpful (Koletzko et al., 2013, p. 239).

The recommendation of the WHO (2003, 2011, 2023) and UNICEF is, that all infants should receive exclusive breastfeeding within the first six months of life. Thereafter, any breastfeeding should be practiced up to the age of two years or beyond. Furthermore, infants should breastfeed on demand, meaning that the child should be able to breastfeed as often as it wants day and night. Also, it is recommended to not use bottles, teats, or pacifiers when possible (WHO, 2003, 2011, 2023).

This recommendation is not completely shared in Germany by the NSK (BfR, 2022). It is stated, that during the first six months of life, breast milk is usually sufficient as the sole food (Max Rubner-Institut, 2019, p. 1). Depending on the child's ability to thrive and eat, complementary foods should be introduced no later than the beginning of the seventh month of life and in no case before the beginning of the fifth month (BfR, 2022). It is further stressed, that introducing complementary foods does not mean weaning, but rather supplementing breastfeeding with appropriate solid foods (BfR, 2022). Thus, breast milk should remain the main food and make up the majority of the diet at least until the end of the first year of life of the child (BfR, 2022; Max Rubner-Institut, 2019, p. 1). The final time for weaning should be an individual decision made jointly by the mother and child (BfR, 2022). Also, the national recommendation is to breastfeed on demand (Bührer et al., 2014, p. 528).

Dettwyler (1995) researched at what age human infants would wean completely if this process depended solely on physiological considerations. With the result that a breastfeeding period of three or four years or even longer is normal and appropriate for human infants; and human babies are designed to expect to receive all the benefits of breastfeeding and breast milk for at least two and a half years (Dettwyler, 1995). Based on this, the recommendation of the WHO seems to be more appropriate, as a longer minimum duration of breastfeeding is recommended. Also, the scientific findings in chapter 2.2 suggest that a longer duration of breastfeeding can have a positive effect, especially on health.

2.3.2 Prevalence

Despite the obviously strong benefits of breastfeeding and recommendations that are in place, the worldwide prevalence of breastfeeding is low and still far away from recommendations: according to WHO and UNICEF (2021, p. 3) worldwide less than half of all babies

are breastfed within an hour after birth, and only 44% of infants under six months of age are exclusively breastfed. 68% are still breastfed at 1 year of age and 44% at two years of age (WHO & UNICEF, 2021, p. 3). Breastfeeding behavior varies widely across countries, being one of the few positive health behaviors that is generally more common in poor than in rich countries, with a prevalence in high-income countries being mostly lower than 20% at 12 months of age (Victora et al., 2016, pp. 477 & 487). Five times as many babies are not breastfed in high-income countries as in low-income countries (United Nations, 2018). Also in terms of exclusivity and duration of breastfeeding, high-income countries are usually worse positioned than low- and middle-income countries, depicting lower rates and shorter durations (Victora et al., 2016, p. 475; WHO, 2022a, 2022b). Nonetheless, low-income countries face the challenge of late initiation and low rates of exclusive breastfeeding (Victora et al., 2016, p. 485-486).

In Germany, there is currently no nationwide breastfeeding monitoring, so the breastfeeding prevalence and duration cannot yet be determined by standardized scientific data (Abraham & Fiack, 2018, p. 909). In the following it is referred to the data of the latest birth cohort (2013/2014) of the repeated cross-sectional survey by the RKI on the health of children and adolescents in Germany (German: Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland; KiGGS) (Abraham & Fiack, 2018, p. 909; A.-K. Brettschneider et al., 2018, pp. 920 & 922). To make it easier to determine the extent to which the breastfeeding rates in Germany are in line with the current recommendations, the corresponding data are represented in a graph (see Figure 5).

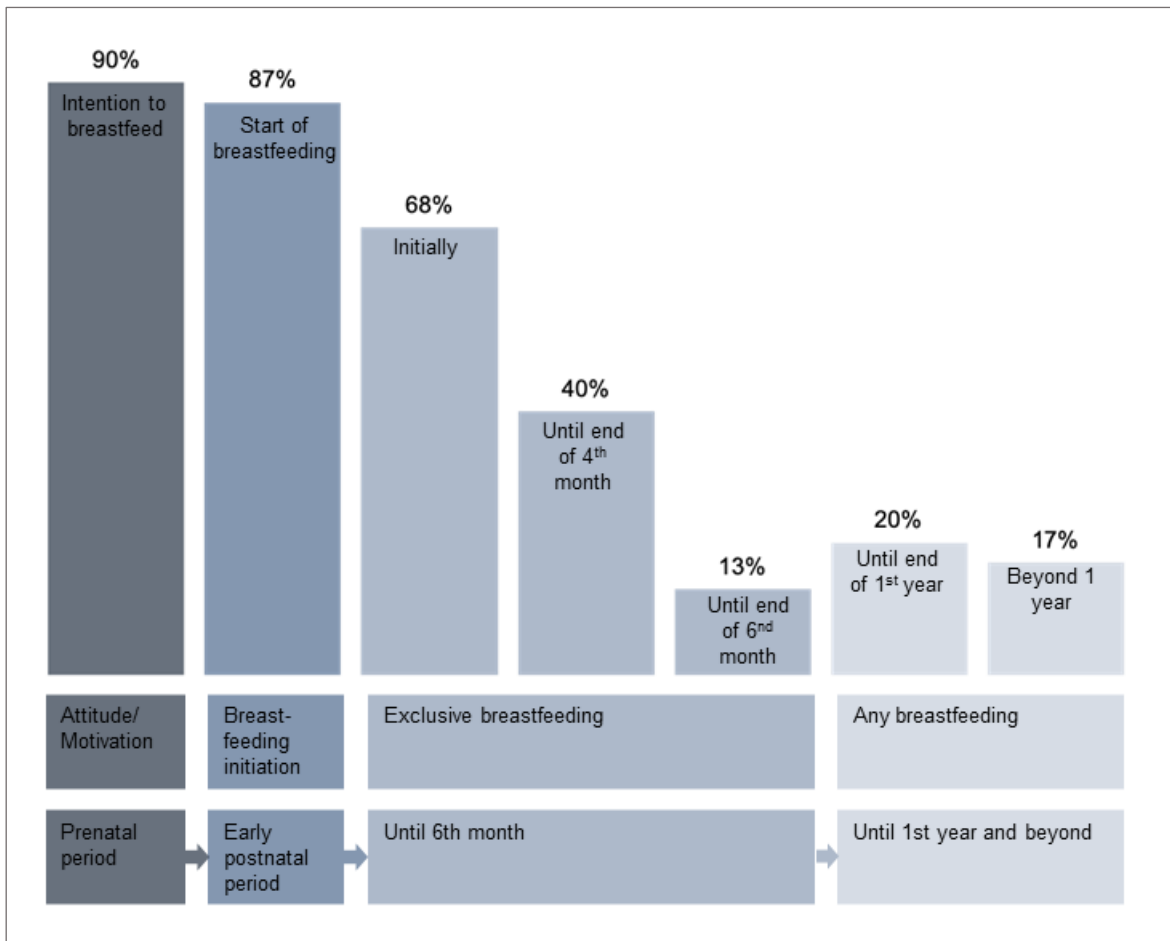


Figure 5: Breastfeeding prevalence in Germany, own figure, in the style of BMEL, 2021b, p. 4

According to Brettschneider et al. (2018, pp. 921 & 924) about 90% of mothers had intended to breastfeed their child after birth, while 87% of all women ever practiced any breastfeeding. Therefore, it can be assumed, that this is equivalent to the number of women, who started breastfeeding somewhat sustainably almost directly after birth. However, only 68% of all women ever breastfed their child exclusively. Within the first six months of life, the proportion of mothers who exclusively breastfed their children decreased rapidly: By the completed second month, it is slightly more than half (57%), by the completed fourth month it is 40%, and by the completed sixth month it is 13%. By that time, 56% practice any breastfeeding, while 20% of children at 1 year of age receive any breastfeeding, and 17% receive any breastfeeding beyond the first year of life (Brettschneider et al., 2018, p. 921 & 924). There is no data available on breastfeeding prevalence at two years of age. Potential reasons for this breastfeeding behavior emerge from the following chapter 2.3.3.

Conclusively, the recommendation for exclusive breastfeeding for at least four to six months (BfR, 2022) is realized by only about one-third and about one-tenth, respectively. Additionally, less than one-fifth breastfeed for longer than one year, which suggests, that even fewer mothers breastfeed until their child is two years old, as recommended by the WHO. Figure

6 should help to get an insight into the breastfeeding status in Germany compared to the global level. It includes the national data just outlined and compares them to the global data taken from the “global breastfeeding scorecard 2021”, that were also outlined in this chapter (WHO & UNICEF, 2021, p. 3 & 4). It is noted that the graphic is only of limited meaning, as due to the unequal survey methods and period, an exact comparison is not possible. However, it is considered sufficient enough to identify an approximate trend.

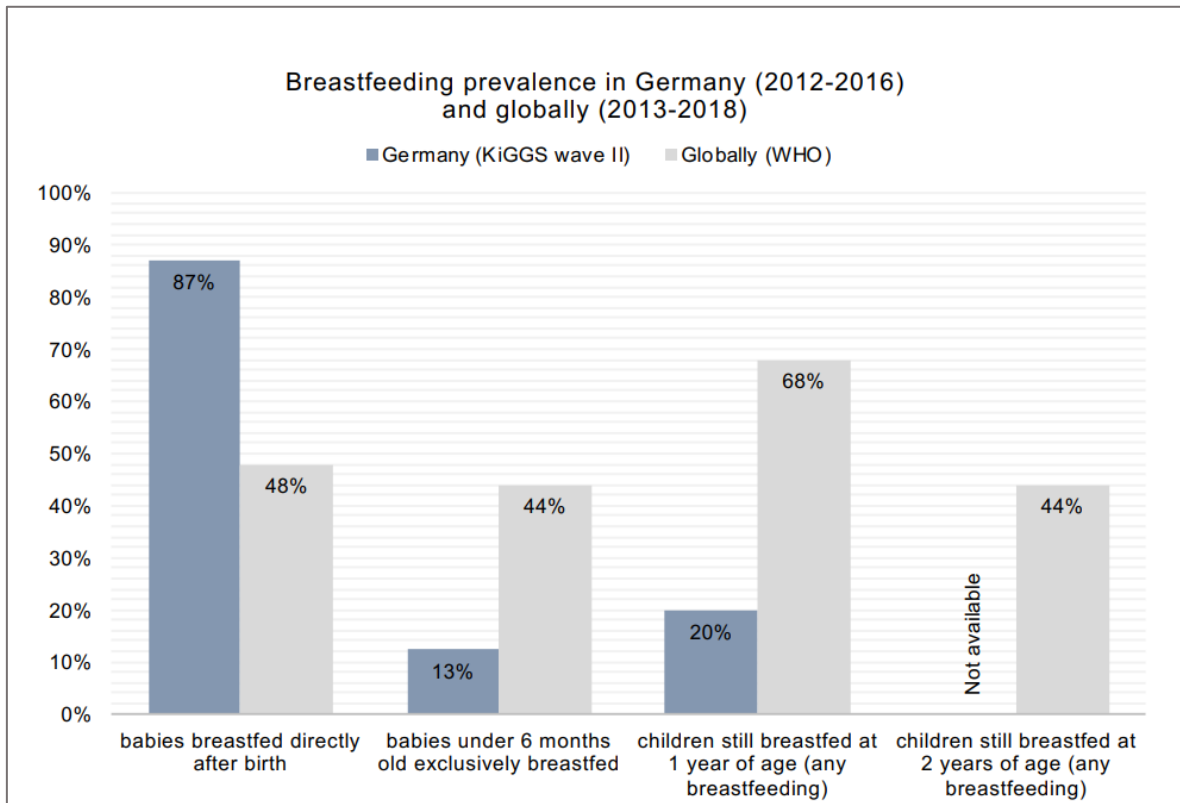


Figure 6: Breastfeeding prevalence in Germany and globally, own figure

According to Figure 6, Germany has a good initiation rate compared to the global level. However, in terms of exclusivity and duration of breastfeeding, Germany is in the lower range in the international comparison. This is in line with the described breastfeeding behavior in high-income countries in general, outlined previously. The global 2030 target set by the WHO and UNICEF (2021, p. 3) is that 70% of babies are breastfed within an hour after birth, 70% of babies under six months old are exclusively breastfed, 80% are still breastfed at one year of age and 60% of children are still breastfed at two years of age. Although Germany's initial breastfeeding rate is already above the stated target, it is very far from the stated targets in all other respects. Against the background of the numerous advantages of breastfeeding (see chapter 2.2) and simultaneously low breastfeeding prevalence, it becomes clear that there is a need for action in Germany to promote breastfeeding, with special attention on the promotion of continuation of exclusive and any breastfeeding.

2.3.3 Determinants

Possible reasons for breastfeeding behavior are diverse. Cultural and social norms play a crucial role, as does the lack of support in the health care system, from fathers, families, employers, and society (United Nations, 2018). Figure 7 shall provide an overview of the different determinants of breastfeeding behavior in general. It illustrates, that whether a mother breastfeeds her child and for how long she does so is not only her personal decision but also depends to a large extent on a variety of factors on different levels. Accordingly, breastfeeding promotion is a task for society as a whole. The government and other central stakeholders such as hospitals, health insurance funds, employers, professional associations, etc. have a responsibility to create the necessary structural framework. Contrary to this, it is clear from the recommendation made by the NSK (see chapter 2.3.1), that in Germany, breastfeeding is largely considered a woman's personal choice and the government has been slow to promote, support, and research breastfeeding (Rouw et al., 2015, p. 1).

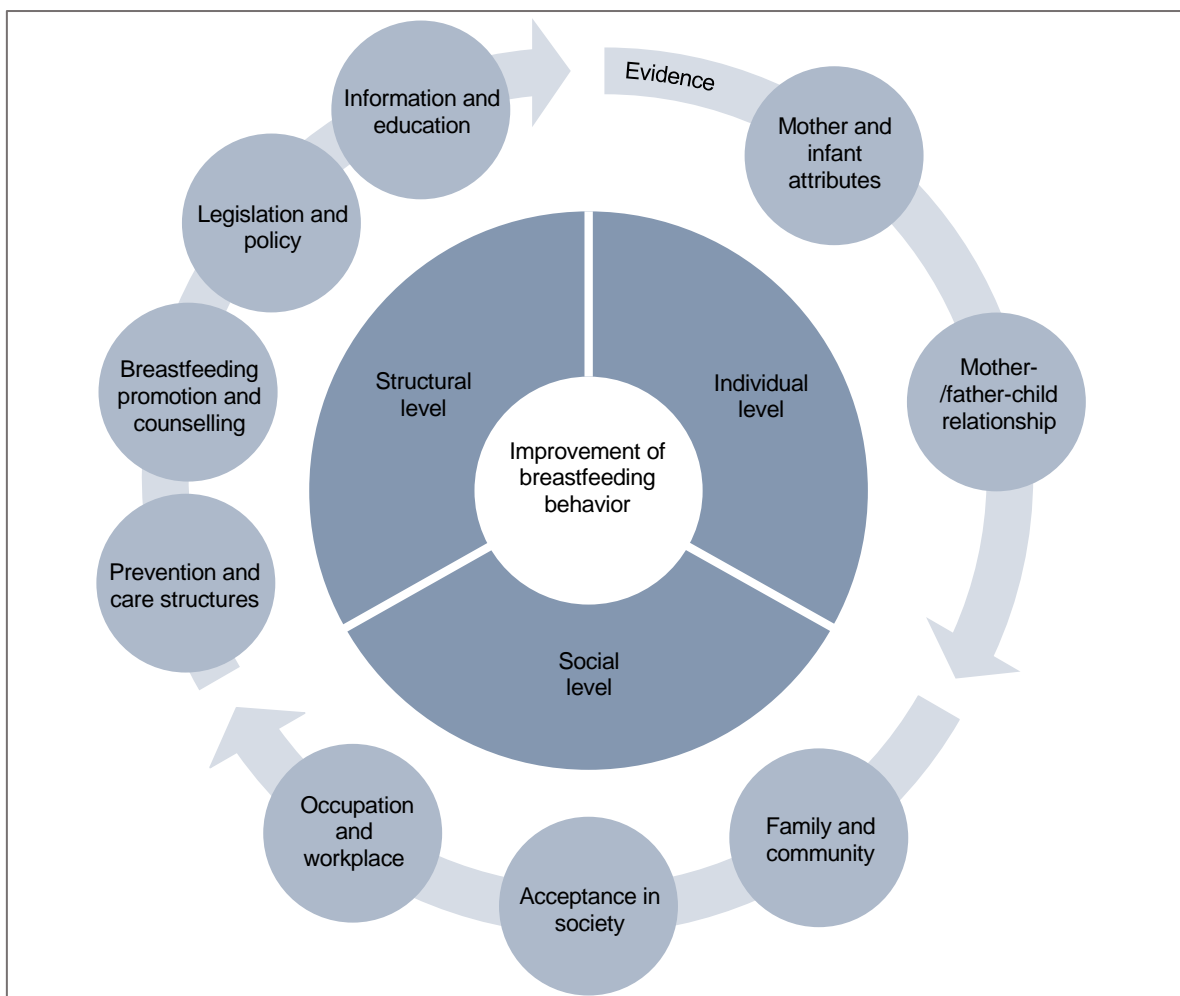


Figure 7: Different levels with related factors influencing breastfeeding behavior, own figure in the style and based on information of BMEL, 2021, p. 5 and Rollins et al., 2016, p. 492

This impression is confirmed by evaluation reports on the breastfeeding-friendliness of Germany. The “World Breastfeeding Trends Initiative” project, examined in early 2018 whether

key points for the protection, promotion, and support of breastfeeding from the Global Strategy for “Infant and Young Child Feeding” of the WHO have been implemented (Rosin, 2018, p. 4). **Germany ranks second last in Europe** (17th out of 18) in the “World Breastfeeding Trends”⁵ and 94th out of 97 countries worldwide (Rosin, 2018, p. 50). Nearly at the same time, another systematic evaluation examining the framework conditions for breastfeeding in Germany was carried out over a period of two years (2017 to 2019) as part of the “Becoming Breastfeeding Friendly” research project, coming to the result that Germany is **moderately breastfeeding-friendly** (BMEL, 2021b, p. 1; Dr. S. Lücke & Reiss, 2019, p. 2).

The evaluations underline the need to introduce breastfeeding promotion measures in Germany. At the same time, they help to recognize the areas of concern. The resulting recommendations were published in June 2019 in the form of a national strategy for the promotion of breastfeeding, and represent the basis for developing and implementing targeted, efficient and sustainable measures (Dr. S. Lücke & Reiss, 2019, p. 2). Besides communication on breastfeeding promotion, which is seen as a cross-cutting task, the strategy is divided into seven strategy areas, including:

- Evidence-based guidelines,
- (Continuing) education,
- Prevention and care structures,
- Community breastfeeding promotion,
- Breastfeeding and work,
- Marketing of breastmilk substitutes and
- Systematic breastfeeding monitoring (BMEL, 2021a, p. 13).

After in the following, some factors on the individual level are described to get a better understanding of the target group and potential confounders for the subsequent systematic review, some of the listed deficient fields on the social and structural level are addressed, without claiming to be complete.

Individual level⁶

Increasing maternal age and a higher income, level of education, and social status of women at birth as well as being married is associated with an increase in the general prevalence, initiation, duration, and exclusivity of breastfeeding (Kersting et al., 2020, p. V 18; Victora et al., 2016, p. 478; von der Lippe et al., 2014, pp. 849 & 852). Mothers with twins, multiple children or preterm infants, smoking mothers (von der Lippe et al., 2014, pp. 852 & 853), those overweight or obese (Fair et al., 2019, p. 7), or mothers who had a

⁵ Comparison of total scores of infant and child feeding practices, policies, and programs (Rosin, 2018, p. 50)

⁶ In this section, information from other high-income countries than Germany is drawn if no literature is available that relates to Germany.

cesarean section delivery (Cohen et al., 2018, pp. 192 & 193) breastfeed significantly shorter and less often. Other risk factors for short duration of breastfeeding include a lack of or low intention to breastfeed, no breastfeeding experience with a previous child, and a lack of positive attitudes towards breastfeeding in the partnership (Kersting et al., 2020, p. V18). Early factors such as the initial promotion of a close mother-child bond, which includes the importance of skin-to-skin contact, and breastfeeding instructions have a positive influence on breastfeeding initiation and duration (Cohen et al., 2018, pp. 192 & 193).

If this is taken further, it could mean that not only breastfeeding promotion measures could be helpful, but also that any form of prevention and health promotion, or improvements in people's living conditions and socio-economic situation, could positively influence breastfeeding behavior. However, this thesis will not be pursued further here. After all, it becomes apparent that the factors influencing breastfeeding prevalence and duration are very diverse, multi-layered, and individual. It can be concluded that the target group that mainly should be considered in prevention measures due to more probable affectedness, seems to be mainly groups of people who are already disadvantaged in various ways or who have certain vulnerabilities.

Social and structural level

One reason for the rather good breastfeeding initiation rates could, among other things, potentially be the provision of breastfeeding support in hospitals and support by midwives after discharge in Germany (Ekström et al., 2014; Hockamp et al., 2022; Rosin, 2018; Rouw et al., 2015). However, there still seems to be a need for an increase in the proportion of baby-friendly hospitals, which seems to have failed so far due to a lack of official and financial support and resources (Rosin, 2018, pp. 12–15; Rouw et al., 2015, p. 3), and also despite basic entitlement to support of a midwife, there is a considerable shortage, so it cannot be made available to every woman who needs it (Rosin, 2018, p. 28). The regular care of a midwife is provided at the expense of the health insurance fund for a certain duration and number of consultations (BZgA, 2021b). Afterward, there is no overarching strategy to support breastfeeding mothers in non-clinical settings in terms of integrated care (Rosin, 2018, p. 28). Even if physicians (general practitioners, gynecologists, pediatricians) are holding an important advisory position for parents (Bier et al., 2021), they are generally not trained in breastfeeding medicine (Rosin, 2018, p. 25). Other services as those of an International Board Lactation Consultant, which are available only in some places, are not paid for by general insurance companies and accordingly, have to be paid by the mother herself (Rosin, 2018, p. 28; Rouw et al., 2015, p. 3). A few community-based breastfeeding support organizations exist in Germany for mothers, including the “working group of free breastfeeding groups” (in German: Arbeitsgemeinschaft Freier Stillgruppen) and the

La Leche Liga (Rosin, 2018, p. 28; Rouw et al., 2015, p. 3). However, these groups hardly reach mothers with a migration background or in difficult life situations (Rosin, 2018, p. 28). Volunteers and professionals working in the field of “early support” (in German: Frühe Hilfen) are also predominantly not trained in breastfeeding topics (Rosin, 2018, p. 29). So, especially in the phase after the start of breastfeeding, there seems to be a lack of support. This could be one factor reflecting the short duration of breastfeeding in Germany.

Another aspect might be the general attitude in German society toward breastfeeding. A study by Lücke et al. (2022) found that in Germany, there has been a decline in social acceptance of breastfeeding in public. About one in six (17% in 2020 compared to 12% in 2016) explicitly agree with the statement that breastfeeding has no place in public. Thereby, the acceptance of breastfeeding on the part of the general population differs according to public places. While acceptance is highest (around 60%) for parks and playgrounds, an acceptance level of 47% is described for long-distance transport (train, plane) and leisure facilities, followed by public facilities (42%), restaurants/ cafés (38%), the workplace (38%), public transport (37%), public toilets (34%), stores (32%) or events (31%) (S. Lücke et al., 2022, p. 1191). At the same time, breastfeeding locations that experience little acceptance in the population are avoided more by mothers (Koch et al., 2018, p. 996). This described stigma seems to be even more present when toddlers and older children are breastfed, as this is met with (even more) incomprehension and prejudice by many people (Winzer, 2013, p. 99). This is despite the recommendation by the WHO to breastfeed for at least two years (see chapter 2.3.1), and although this also seems physiologically appropriate (see chapter 2.3). Nevertheless, in 2020, a greater proportion of mothers breastfed in public places than in 2016, whereas mothers with lower levels of education are generally less likely to breastfeed in public than mothers with higher levels of education (S. Lücke et al., 2022, p. 1189). About half of all women (48%) with breastfeeding experience in public places reported avoiding breastfeeding outside the home; women with a higher level of education do this more likely out of their own choice, while women with a lower level of education are more likely want to avoid social reactions (S. Lücke et al., 2022, p. 1189). Places women were most likely to avoid for breastfeeding included public toilets (58%), public transport (48%), and the workplace (43%) (S. Lücke et al., 2022, p. 1191). Based on the available results, no specific target group in the population can be identified for improving the acceptance of public breastfeeding, as no specific demographic characteristics were observed in individuals with a negative attitude toward breastfeeding in public (Koch et al., 2018, p. 992; S. Lücke et al., 2022, p. 1194). One aspect that might contribute to this general stigma and lack of support for breastfeeding, is a lack of sufficient information, as knowledge about the positive effects of breastfeeding is associated with greater acceptance of public breastfeeding (Koch et al., 2018, p. 992; S. Lücke et al., 2022, p. 1194). Simultaneously,

knowledge about the health effects of breastfeeding is lower in the general population than among mothers (S. Lücke et al., 2022, p. 1193), which suggests that in the general public, also social acceptance is lower.

It becomes clear that in Germany especially already disadvantaged population groups are affected, while a support system focusing on a later phase of breastfeeding is lacking. At the same time, breastfeeding and especially breastfeeding over a longer duration seems to be stigmatized in German society. Finally, these aspects describe only few aspects that might explain the outlined breastfeeding behavior in Germany. Figure 7 depicts the vast amount of in part interconnected determinants, many of which appear to be deficient in Germany (BMEL, 2021a, p. 13).

Figure 8 provides further indications of the fields of action in Germany, by provision of reasons for weaning in Germany. It confirms, that a comprehensive approach to promoting breastfeeding is needed as the reasons for weaning are very diverse. They seem to vary significantly depending on when weaning occurs. Therefore, tailored support for breastfeeding should be provided at different stages.

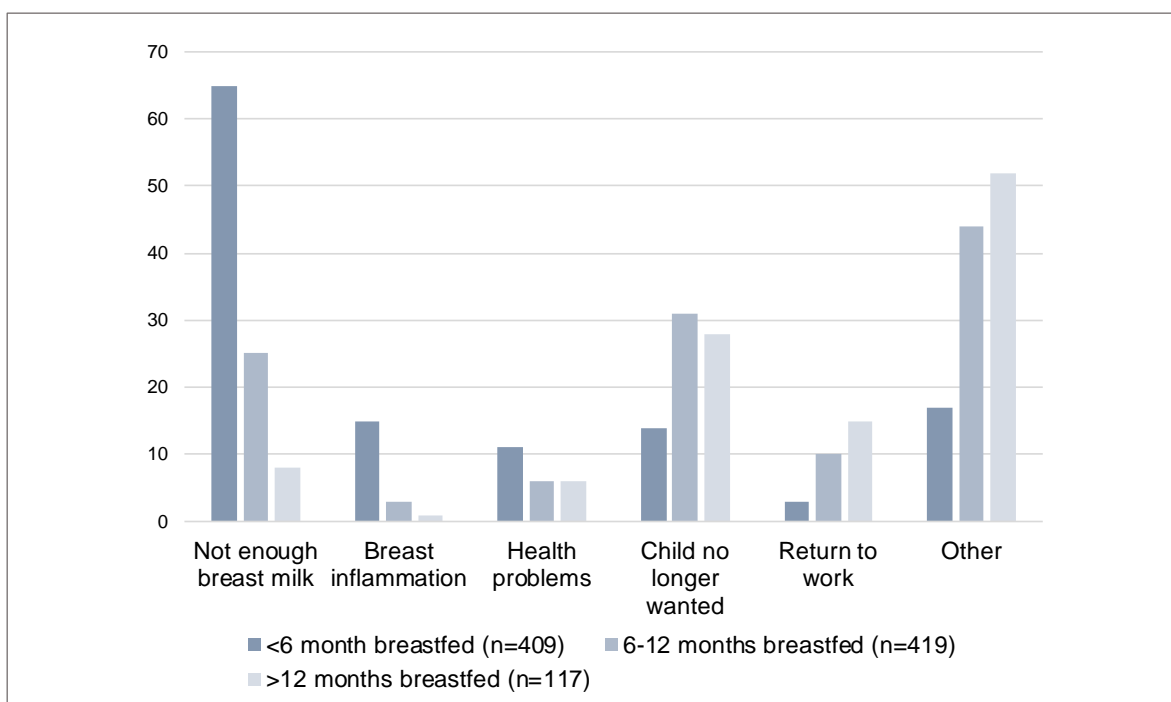


Figure 8: Reasons for weaning by the duration of any breastfeeding in Germany, specified in percent (%), own figure according to Brettschneider et al., 2018, p. 923

Figure 8 not only illustrates, that despite the support structures described above for the start of breastfeeding, there is still a need for further action in this stage. It also becomes apparent, that the return to work of the mother seems to represent a reason for weaning in particular when the child is older than a year; but also, in the age of six to twelve months, this

seems to be a considerable factor. Other weaning reasons will not be discussed in more detail in order to not exceed the scope of the work.

That the return to work represents a reason for weaning is also confirmed by the fact that according to Kersting et al. (2020, p. V22), only 35.9% of working mothers continued to breastfeed their children during employment, while breastfeeding was supported at work for 64.2% of these mothers, which depicts the potential relevance of breastfeeding support at the workplace. The difficulty of combining breastfeeding and work is also depicted by the fact, that during the time that mothers fully breastfed their child, 92.3% were not working, 6.8% were working hourly or part-time, and 0.9% were working full-time (Kersting et al., 2020, p. V22). Finally, combining full breastfeeding and work is uncommon in Germany, while support by the workplace, whether full-time or part-time work is performed, and the length of maternity leave seems to have an influence on breastfeeding behavior, as mothers who work full-time tend to wean earlier (Mirkovic et al., 2014, p. 2). In the next chapter, the current circumstances for working mothers in Germany, including political and legal provisions, become clear.

2.4 Work-related Conditions for Mothers in Germany

2.4.1 Labor Market Participation

Nowadays it is no longer widespread in Germany that mothers mainly take care of the children and the household, but rather a multitude of different family models exists (Diabaté, 2014). In fact, **women are representing an increasing share of the labor force** since the 20th century (Ortiz-Ospina et al., 2018). Furthermore, according to Geis-Thöne (2017), mothers are **returning to work earlier** after pregnancy than ten years ago. While the share of mothers working in the first year of life fell from 22.5% to 8.5 % between 2006 and 2014, the share of mothers working in the second year of the child's life rose from 34.6 % to 42.8%, and in the third year from 44.1% to 57.6%. One reason for this is recognized in the structure of the parental benefit (German: Elterngeld), which seems to create a protected space for young families in the first year and then promotes the early re-entry of mothers into the labor market. The introduction of the "parental benefit plus" (German: Elterngeld Plus) in 2015, may have once again changed the participation trend of mothers in the labor market, because this makes it more attractive for mothers to return to the labor market part-time even earlier, namely during the child's first year of life (Geis-Thöne, 2017). Indeed, since the introduction of the "parental benefit plus", its share of parental allowance payments has risen continuously (Federal Statistical Office, 2023a; Geis-Thöne, 2017). Most recently, in the third quarter of 2022, it accounted for 43.5%, while women in particular took advantage (Federal Statistical Office, 2023a). These results lead to the suggestion, that a

significant proportion of mothers are now re-entering the labor market before the child's first birthday (Geis-Thöne, 2017).

According to the Statista Research Department (2022), caring for children is one of the main reasons women in Germany work part-time, while the same reason is much less important for male employees. Parental leave rates in Germany also highlight the differences between the sexes (Statista Research Department, 2022). This is, among other things, reflected in the "**gender gap labor market**", taking into account differences in gross hourly earnings, working hours, and labor force participation of women and men; in 2022, the gender gap labor market was 39% in Germany (Federal Statistical Office, 2023b). It shows not only, that women are more likely to work part-time, but also that are less likely to participate in the labor force at all and earn less per hour (Federal Statistical Office, 2023b). As described by Diabaté (2014), it is suggested that in many cases, this disparity can lead to an overall economic imbalance in partnerships. Economic and social constraints can thus limit the freedom of choice to shape one's life as desired. Overall, it can be seen that the two basic principles of gender equality and "responsible parenthood" compete with each other (Diabaté, 2014). The pandemic has further highlighted this conflict that mothers often experience, and at the same time has exacerbated the multiple burdens placed on mothers, which can be seen from a study by Gundula Zoch and Bächmann (2020). The data show that during the crisis, mothers in particular had the central role in caregiving, whether it was homeschooling or when childcare was unavailable. And even when both parents had similar workloads, women were more likely to provide child care alone. In addition, the group of mothers with children worked significantly more during the first lockdown than before (Gundula Zoch & Bächmann, 2020).

This clearly depicts the relevance of **childcare arrangements** for mothers to participate in the labor market. It is regulated in Germany that from the completed first year of life there is a legal entitlement to a care place for the child (§ 24 SGB VIII, paras. 2-4). A child who has not yet reached the age of one has this claim as well if the legal parents are in employment, are taking up or are seeking such employment (§ 24 SGB VIII, para. 1). Despite the existing legal entitlement, there is a shortage of places in childcare, especially in large cities and metropolitan areas (Statista Research Department, 2022). Daycare places for children under three are most affected (Schmitz et al., 2023, p. 5). In Germany, the childcare rate for children aged three to six averaged 91.9% in 2021, compared with about 34.4% for those under three (Statista Research Department, 2022). For 2020 a shortage of almost 350,000 childcare places for under-threes was calculated, which is around 60% more than five years ago (Geis-Thöne, 2020). From the child's tenth month of life, more and more children use and need a daycare center (Schmitz et al., 2023, p. 5). Conclusively, despite an increase in the number of childcare places, many local authorities are unable to meet the legal

entitlement to a childcare place in Germany due to the increased demand (Geis-Thöne, 2020). Also, employers are reacting to this development paired with the increasing importance of reconciling work and family: The number of daycare facilities for children of company employees has risen steadily in recent years (Statista Research Department, 2022). In 2022, there were 795 company daycare centers (Rudnicka, 2022).

This development of mothers re-entering the workplace earlier, as well as that this is also politically intended, stresses the importance of support systems for breastfeeding in the workplace and corresponding settings like childcare facilities. Otherwise, the increased importance for women to unite employment and family could lead to children being weaned even earlier. This in turn would have implications for the health of both mother and child, but also for society as a whole (see chapter 2.2). Additionally, reconciling breastfeeding with labor market participation could help to better unite the principles of **gender equity** and responsible motherhood, if the mother does not have to compromise on either side. This would then be accompanied by improved **financial justice**. The following chapter shows what legal basis already exists for workplaces in Germany with regard to the protection of nursing mothers.

2.4.2 Legal Regulations for Breastfeeding Mothers

One main element is the Maternity Protection Act (German: Mutterschutzgesetz; MuSchG), which applies in principle to every person who is pregnant, has given birth to a child, or is breastfeeding (§ 1 MuSchG, para. 4), and the Federal Parental Allowance and Parental Leave Act (German: Bundeselterngeld- und Elternzeitgesetz; BEEG). From § 1 MuSchG, para. 1-3 it emerges, that most of the provisions are addressed to employers. Whereas in the case of the self-employed or in the informal sector no employer is responsible and the relevant provisions come to nothing. When presenting the basic statutory provisions, some details and special features are not considered (e.g. those relating to the period of pregnancy or to pupils or trainees).

Time-related

It is specified that after giving birth, mothers should be protected for a certain period of time. This protection usually lasts for eight weeks and during this time, it is not allowed for the mother to work (§ 3 MuSchG, para. 1). In addition, according to the BEEG, entitlement to parental leave exists until a child reaches the age of three, while a portion of up to 24 months can be taken between the third birthday and the child's completed eighth year (§ 15 BEEG, para. 2). There are different models for pro-rated payment in form of parental allowance (§ 4 BEEG). Depending on the type of allowance, this can be received up to the 32nd month of the child's life (§ 4 BEEG, para. 1). Therefore, regulations in Germany go beyond the

specifications of the International Labour Organization (2000), which for example with regard to maternity leave length define a minimum of 14 weeks (Convention No. 183, article 4, para. 1).

According to § 4 MuSchG employers may not employ a nursing woman to perform work that requires her to work more than eight and a half hours a day or more than 90 hours in a double week. In addition, an uninterrupted rest period of at least eleven hours after completing the daily work period must be given. Despite some exceptional procedures, § 5 MuSchG generally specifies the prohibition of night work (between 8 pm and 6 am), and on Sundays and public holidays (§ 6 MuSchG, para. 1). In addition, the time for breastfeeding is secured by the Maternity Protection Act (§ 7 MuSchG, para. 2). However, this provision only applies during the first twelve months after birth: At least twice a day for half an hour or once a day for an hour. In case of continuous working time of more than eight hours, a breastfeeding period of at least 45 minutes shall be granted twice at the mother's request or, if no breastfeeding facilities are available near the workplace, a breastfeeding period of at least 90 minutes shall be granted once. The working time shall be considered continuous if it is not interrupted by a rest break of more than two hours (§ 7 MuSchG, para. 2). The granting of time off for examinations and breastfeeding breaks must not result in a loss of pay for the employees. Also, the time may not be made up before or after by the employee and shall not be counted towards rest breaks (§ 23 MuSchG, Para. 1).

Space related

The mother's right to suitable spatial conditions for breastfeeding or obtaining breast milk is implicitly regulated in two paragraphs of the MuSchG. In § 9 MuSchG, para. 3, it is described, that the employer shall ensure that the breastfeeding woman can briefly interrupt her work at the workplace as far as it is necessary for her. It must be ensured that the breastfeeding woman can lie down, sit down, and rest under suitable conditions during breaks and work interruptions (§ 9 MuSchG, para. 3). In § 29, para. 3 it is stated, that the supervisory authority (German: Aufsichtsbehörde) in particular may order details of the provision of suitable premises for breastfeeding. So, it must be ensured that breastfeeding does not take place in unsuitable premises, such as in the toilet, but no general obligation to provide a breastfeeding room emerges from a legal basis.

However, if premises are provided, there are technical rules for workplaces (German: Technische Regeln für Arbeitsstätten; ASR), that provide practical guidance to achieve the protection goals and requirements set out in the Workplace Ordinance (German: Arbeitsstättenverordnung; ArbStättV) with regard to the safety and health of employees (BAuA, 2023). They contain the current state of the art, and thus are intended to make it easier for employers to carry out the risk assessment in accordance with §3 of the ArbStättV, as well as

to determine suitable measures ASR (BAuA, 2023). Nevertheless, within ASR A4.2, section 6 information on how facilities for nursing mothers should be designed is provided (Technische Regeln für Arbeitsstätten. Pausen- und Bereitschaftsräume., 2012). The content is roughly summarized in Figure 9. It should be noted that the exact wording is not reproduced. However, there is no obligation to apply the ASR (BAuA, 2023).

ASR A4.2 Break and on-call rooms – Facilities for pregnant women and nursing mothers	
6 (1)	Availability of facilities for lying down, resting, and breastfeeding at the workplace or in the immediate vicinity in a number that ensures usability at all times. Privacy shall be ensured during use.
6 (2)	Facilities shall be padded and equipped with washable or disposable coverings.
4.1 (5)	Break rooms/areas must be easily and safely accessible via traffic routes. The time required to reach the break rooms should not exceed 5 minutes per route (on foot or by company-provided means of transport). The distance to break areas shall not exceed 100 meters.
4.1 (6)	Break rooms and break areas may not be set up underneath suspended loads or in areas where there is a risk of falling objects.
4.1 (7)	Adverse effects, e.g. from vibrations, dusts, vapors, or odors, must be excluded as far as possible. The average sound pressure level during usage must not exceed 55dB(A).
4.1 (8)	Break rooms and break areas must be free of work-related disturbances (e.g. due to production processes, public traffic, telephone calls).
4.1 (9)	A floor space of at least 1.00m ² each, including seating and a table, must be provided for employees who are to use the room or area simultaneously. Areas for other furnishings, access points, and traffic routes must be added (see ASR A1.2 "Room dimensions and movement areas"). The floor area of a break room must be at least 6.00 m ² . The clear height of break rooms shall comply with the requirements of ASR A1.2 "Room dimensions and movement areas".
4.1 (10)	Break rooms shall have a line of sight to the outside. Such a line of sight is recommended for break areas.
(11)	Break rooms and break areas shall <ul style="list-style-type: none">▪ have as much daylight as possible and be adequately lit (see ASR A3.4 "Lighting"),▪ be sufficiently tempered (see ASR A3.5 "Room temperature"), and▪ have sufficient quantities of breathing air that is beneficial to health (see ASR A3.6 "Ventilation").

Figure 9: Specifications of ASR A4.2 - Break and on-call rooms - Facilities for pregnant women and nursing mothers, own figure

Social and health-related protection

Protection against dismissal persists until the end of the protection period after birth, but at least until the expiry of four months after giving birth (§ 17 MuSchG, para. 1). Also, for the time of parental leave, which can be taken after the maternity protection period, there is a special regulation for protection against **dismissal**, according to § 18 BEEG. Furthermore, based on the "General Equal Treatment Act" (German: Allgemeines Gleichbehandlungsgesetz; AGG) there is a general prohibition of **discrimination** on the grounds of gender (§ 7 AGG, para. 1).

Furthermore, there are general regulations regarding occupational **health** protection, according to which employers must employ the breastfeeding woman and arrange the workplace in such a way that the breastfeeding woman and her child are adequately protected against hazards to life and health. This includes, according to § 9 MuSchG, para. 1, that when designing the working conditions, the employer must take all measures required on the basis of the mandatory risk assessment (§ 10 MuSchG) to protect the physical and mental health of the breastfeeding employee and her child. Employers shall review the

measures for their effectiveness and, if necessary, adapt them to changing circumstances (§ 9 MuSchG, para. 1). In general, according to § 9 MuSchG, para. 2, employers are legally obligated to exclude irresponsible hazards for breastfeeding women and their children. A hazard is irresponsible if the probability of occurrence of impairment to health is unacceptable in view of the expected severity of the possible damage to health (§ 9 MuSchG, para. 2). The MuSchG contains a number of examples of activities and working conditions that may pose an irresponsible risk. For example, in § 12 MuSchG, it is stated that the employer may not allow the breastfeeding woman to perform any activities or expose her to any working conditions that pose an irresponsible risk to her physical or mental health or that of her child. Which factors in total permit employment of a breastfeeding woman can be read in more detail in the same paragraph (§ 12 MuSchG), including for example exposures to:

- Hazardous substances (chemical substances, e.g. substances harmful to fertilities),
- Biological substances (viruses, bacteria, fungi),
- Physical effects (ionizing and non-ionizing radiation),
- A stressful working environment (in rooms with excess pressure), or
- Activities with a prescribed work pace.

If there are irresponsible hazards according to § 9, § 11 or §12, the employer must take protective measures according to § 13 MuSchG, para. 1: If the working conditions cannot be altered by protective measures, the woman may be deployed at another suitable workplace or task. However, if the irresponsible risk cannot be excluded by both options, the employer may not continue to employ the breastfeeding woman. An employment prohibition must be imposed (§ 13 MuSchG, para. 1). All this also applies when working in home-office (§ 13 MuSchG, para. 2). Derived from above, an employment prohibition might for example be relevant for dentists, veterinarians, and pilots or flight attendants.

During the time when working is prohibited for the women, she receives wage compensation corresponding to the average salary of the last three calendar months (§ 18 MuSchG). At the same time, according to § 1 Compensation of Expenses Act (German: Aufwendungsausgleichsgesetz – AAG), para. 1, the employer is entitled to reimbursement in full from the statutory health insurance funds for the remuneration paid to breastfeeding women. In contrast to the release of the mother due to breastfeeding regulated in § 7 MuSchG (for example, granting breaks for breastfeeding/pumping), health protection, which is the subject of § 12 MuSchG, is not limited in time.

2.5 Contribution to the Sustainable Development Goals

The relevance of the topic is underlined by highlighting the fact that successful breastfeeding promotion at the workplace could contribute to the achievement of many SDGs forthcoming by 2030 (United Nations, 2022; Victora et al., 2016, p. 488), namely those depicted in Figure 10.



Figure 10: Sustainable Development Goals supported by breastfeeding promotion at the workplace, icons by United Nations, 2022

As apparent from chapter 2.2, the promotion of breastfeeding contributes obviously to the third SDG “Good Health and Well-Being”, as breastfeeding can improve and maintain maternal and child health in many different ways, including e.g. non-communicable diseases such as breast and ovarian cancer, diabetes, overweight and obesity. It contributes to the second SDG “Zero Hunger”, with breastfeeding being the natural and ideal feeding method for infants, realizable without any extra cost. The positive effect on the brain development of the breastfed child is relevant to the fourth SDG “Quality Education”. Additionally, as breastfeeding avoids negative environmental effects due to the production of bottle feeds, a contribution can be made to the SDGs “Climate action” and “responsible consumption and production”. In combination with the positive effect of breastfeeding on human capital (see chapter 2.2), it is clarified in chapter 2.4.1, that by preventing poverty among women (and indirectly also children) through an early, potentially improved compatibility of family and work), a contribution is made to the SDG “No Poverty” and the eighth SDG “Decent Work and Economic Growth”. In the same chapter, it is further described that the promotion of breastfeeding at the workplace can promote gender equality and therefore contributes to SDG five.

2.6 Current State of Research

Besides other approaches to promote breastfeeding in the workplace, the national strategy for breastfeeding promotion, mentioned already in chapter 2.3.3, identifies a current need for research with regard to the identification of breastfeeding promotion measures implemented at (inter)national level; whereupon the identified measures should then be compared with the legal framework in Germany to check feasible in this context. It is stated, that potential research questions of interest are for instance concerned with the nature, way of implementation, or effectiveness of measures taken to promote breastfeeding-friendliness in companies. Further, it is described that research is needed as a basis to develop recommendations and best-practice examples, and finally to encourage companies to introduce breastfeeding-friendly measures. The importance of providing information appropriate to the target group is addressed, not only including breastfeeding-related regulations from the MuSchG but also going beyond by outlining possibilities for applied breastfeeding-friendliness in the company. The addressees include, among others, employers and company stakeholders (BMEL, 2021a, p. 11; Dr. A.-K. Brettschneider et al., 2021, pp. 66–71). The national strategy thus seems to demonstrate the current need for this research work and emphasizes the relevance of the chosen topic.

This is confirmed since there seems to be a lack of studies on the effectiveness of interventions to support breastfeeding at the workplace (Tang et al., 2021); especially in comparison to literature discovering other fields of action like the promotion of breastfeeding in the hospital and community setting (Sinha et al., 2015). Five review articles were found that present strategies that can be implemented by employers at the workplace to potentially improve breastfeeding outcomes. To get an idea of expected results and preexisting knowledge on the topic of interest, the results are briefly summarized, with a focus on the interventions under investigation, in Table 1.

	Hilliard (2017)	Hirani and Karmaliani (2013)	Kim et al. (2019)	Tang et al. (2021)	Vilar-Compte (2021)
Group education/ breastfeeding classes		X	X	X	X
Individual or telephone support/ consultation	X		X	X	X
Breastfeeding room/ space	X	X	X	X	X
Breastfeeding breaks/ job-flexibility	X	X		X	X
Workplace policy	X	X		X	X
On-site child care	X	X			
Supervisor/ coworker support	X		X		X
Provision of breast pumps		X	X		X
Flexibility to work from home					X
Enhancing awareness about benefits of breastfeeding accommodation at the workplace among employers		X			
Breast milk storage		X			

Table 1: Interventions investigated by published reviews, own table

Among the here presented reviews (see Table 1), Tang et al. (2021, p. 1501) conducted the most up-to-date systematic review and meta-analysis in April 2020 discovering, that in general, workplace programs may be effective in promoting breastfeeding among employed mothers and partners of employed fathers; both, qualitative and quantitative studies were assessed. Vilar-Compte (2021, p. 1) conducted a systematic review that includes qualitative and quantitative studies as well. Studies published between 2008 and 2019 were included, with the result that workplace interventions help to increase the duration of breastfeeding and prevent the early introduction of breastmilk substitutes. Breastfeeding space, breastmilk extraction breaks, and organizational policies are determined as key strategies. But it is also considered important that organizational and interpersonal changes need to occur in order to achieve equitable working conditions for breastfeeding mothers (Vilar-Compte et al., 2021, p. 1). Less up-to-date is the review published by Hilliard (2017, p. 33) where the research process was finished in 2015. The result was that corporate breastfeeding programs, on-site child care, and a return to work/ telephone consultation were consistently associated with breastfeeding at 6 months, while other accommodations like breastfeeding space, breaks, worksite breastfeeding policies, and supervisor/ coworker support were not (Hilliard, 2017, p. 33). The systematic review by Kim et al. (2019, p. 100) searched only studies conducted in the USA. The search process was finished in September 2017. The conclusion was that breastfeeding interventions at the workplace increase breastfeeding outcomes, with greater changes observed with more available services (Kim et al., 2019, p. 100). The review of Hirani and Karmaliani (2013, p. 10) is the oldest mentioned here. The search was conducted at the end of 2008 and the beginning of 2009. Also, it represents a literature review rather than a systematic review. It aimed to explore workplace interventions that can promote breastfeeding practices among working mothers in Pakistan (Hirani & Karmaliani, 2013, p. 10). All mentioned studies claimed, that better-quality research on workplace interventions to improve breastfeeding is needed and no randomized controlled trials were identified.

With the exception of the reviews of Tang et al. (2021) and Vilar-Compte (2021) the respective research work dates back more than 5 years, while additionally, one source does not represent a systematic review (Hirani & Karmaliani, 2013). Another is limited to one specific country (Kim et al., 2019). However, also the literature search of the most up-to-date systematic review and meta-analysis conducted by Tang et al. (2021) dates back about three years, while the one by Vilar-Compte (2021) dates back about four years.

Within these last years, the Corona pandemic has changed the world of employment and is likely to continue to do so (Federal Ministry for Economic Affairs and Energy, 2021, pp. 1 & 13). For example, in many companies in Germany, home office options have become commonplace and even after the pandemic, this way of working will be an integral part of

everyday working life for many employees (Federal Ministry for Economic Affairs and Energy, 2021, p. 2). Given these recent developments, it seems possible that new studies on the topic have been conducted, e.g. the effects of having the opportunity to work from home might have received more attention. Indeed, this is a topic that is still understudied if considering the few (n=3) findings included in the systematic review by Vilar-Compte et al. (2021, pp. 4, 6, 8, 12 & 17), which are either qualitatively generated, rather old, or are not related to significant findings (Jackowitz, 2008; J. P. Smith et al., 2013, p. 67; Spagnoletti et al., 2017). There might be hope that studies have been conducted in Germany in recent years and that the number of high-quality, experimental studies has increased.

Against this background, and as the existing reviews don't seem sufficient to conduct an umbrella review, it seems appropriate to conduct another systematic review of primary studies in this field. Especially with regard to the transferability of identified interventions to the contextual conditions in the German country, as far as known there is no such research study until now. Due to this focus on Germany, the eligibility criteria will also differ from those of the previous reviews, e.g. only studies conducted in high-income countries are included. Thus, a demarcation to existing research is guaranteed and at the same time, the implementation is justified. It is noted, that for this reason, the results could also end up differing.

3 Methodology

3.1 Study Design

The design of a systematic review is chosen in order to comprehensively synthesize the results of relevant studies in a structured manner (Aromataris & Munn, 2020a, p. 15). The systematic review is conducted following the guidance of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page et al., 2021), complemented by guidance provided by the “Cochrane Handbook for Systematic Reviews of Interventions” (Higgins et al., 2022) and by the Joanna Briggs Institute (JBI), using the “JBI Manual for Evidence Synthesis” (Aromataris & Munn, 2020b). These primary sources to guide through the method of conducting the systematic review are extended by other references in a complementary manner if considered reasonable.

3.2 Eligibility Criteria

The eligibility criteria are presented in the form of a variant of the PICO format (P=participants; I=intervention; C=comparison; O=outcome). A variant is used in adding the following variables: “T” for timeframe, “S” for study design, “C” for context, which in this case is related to geographical information and language, and “P” for publication status (Holcroft, 2023). So finally, the PICO format changes to PICOTSCP for this research, which is summarized in Table 2.

PICOTSCP	Inclusion criteria	Exclusion criteria
Participants/ Study population	Employed women of all ages and professions returning (or having returned recently) to work after giving birth, being (or having recently been) exposed to interventions or workplace characteristics focused on promoting breastfeeding in the workplace.	Self-employed women, pupils or students in settings that do not constitute a workplace (e.g. school or university settings).
Intervention/ Exposition	All types of workplace-level interventions focused on breastfeeding support, that are under the influence of employers in Germany.	Articles focusing on the effect of the quality of certain interventions. Studies investigating measures that (in Germany) are not within the employer’s sphere of influence, e.g. maternity leave.
Comparison	Studies with any or none comparator/ control are included.	-
Outcome	Any direct breastfeeding indicator relating to the duration/continuation of breastfeeding.	Studies reporting indirect indicators/ intermediate variables for improvement of breastfeeding. Articles focusing on breastfeeding initiation.
Timeframe	Studies published within the past ten years (2013-2023).	-
Study design	Primary quantitative study designs.	Case studies.
Context	Studies written in English or German and published in high income countries.	-
Publication status	The study has to be published and the free full text must be available.	-

Table 2: Eligibility criteria, own table according to PICO-format

The **study population** is chosen as described because it represents the group of people that is of interest with regard to the research question. Self-employed women are excluded against the background that this research focuses on measures that can be initiated by the employer. Since the focus of the research is the workplace setting, pupils and students in

settings such as schools or universities are excluded. This is because, for those target groups, more specific or other regulations and contexts could become relevant. Though, if a university is considered from the worksite point of view, the study is included.

Interventions are included when they focus on breastfeeding support in a working environment. It is noted, that this covers both, explicitly introduced breastfeeding promotion interventions as well as workplace characteristics that could improve breastfeeding outcomes. This is also the case even if the study does not mention any specific interventions to create this breastfeeding-promoting environment. At the same time, only measures that are influenceable by the employer or corresponding occupational health professionals are included. Examples are designated places for breastfeeding, or providing breast pumps. As the aim of this systematic review is to identify possibilities for employers to promote breastfeeding in the working environment, governmental measures such as maternity leave (in Germany) are excluded. This allows to identify measures that can be implemented simply and directly by employers. Also, articles focusing on full- or part-time work status, or commute time to work are not included because the interventions are not in direct power of the employer. Also, studies are excluded that investigate how the quality of an intervention, e.g. a breastfeeding room, affects breastfeeding outcomes, as this does not fit the research question. According to what previous research shows (see chapter 2.6), a lack of controlled studies can be expected. That is why no limitation is made with regard to a **comparison** group. Studies are included if they investigate at least one **outcome** related to the duration or continuation of breastfeeding. Variables that are not direct indicators of improvement in breastfeeding practices, such as studies reporting intention to breastfeed, attitude, self-efficacy, perceived support, or knowledge, are excluded. These represent intermediate variables that are assumed to positively influence actual breastfeeding practices. However, only studies should be included that examine an outcome variable that can be clearly inferred to improve breastfeeding practices. Another tangible outcome variable, namely breastfeeding initiation, is excluded, as rather earlier approaches and accordingly other settings than the workplace (e.g. hospitals) are considered to be in demand when it comes to promoting initiation rates and because the return to work is rather a reason for weaning after the sixth month of the child in Germany (see chapter 2.3.3). Furthermore, in this country, breastfeeding duration (of exclusive and any breastfeeding) seems to be the main challenge to be addressed (see chapter 2.3).

In order to consider the answer to the research question about the effectiveness of measures for breastfeeding promotion, quantitative rather than qualitative **study designs** are included. Further, studies with the highest possible level of evidence should be included. Purssell and McCrae (2020, p. 10) present a generic hierarchy of evidence. Complemented

with information from Thiese (2014), Figure 11 emerged, depicting the degree of evidence for the different study designs.

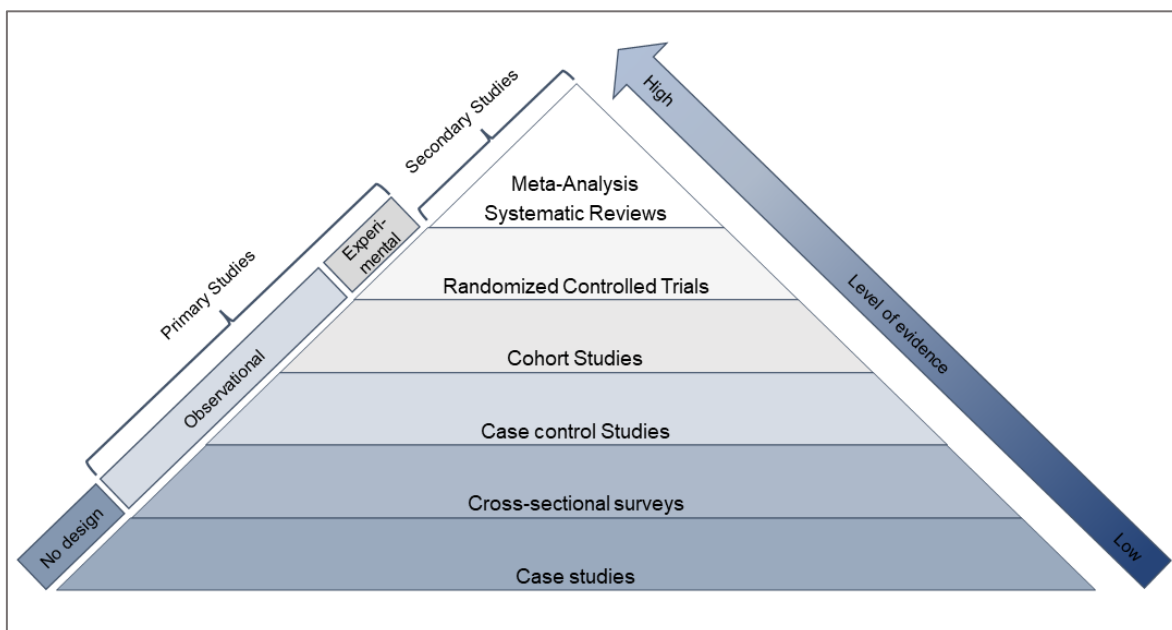


Figure 11: Level of evidence for different study designs, own illustration

Even though secondary studies provide the highest level of evidence, these types of studies are excluded. It is inappropriate to include literature reviews because the material used should be original studies, “(...) not a second-hand account of these studies.” (Pursell & McCrae, 2020, pp. 21 & 22). Furthermore, there do not seem to be enough secondary studies available (see chapter 2.6) to conduct an umbrella review (Choi & Kang, 2022). Additionally, case studies are excluded, comprising no design articles like expert opinions or editorials, as they are not representing a study and are of low evidence (see Figure 11). Therefore, finally, all primary quantitative studies are included.

To enhance the applicability of the results of the research to Germany despite the expected low availability of German studies (see chapter 2.6), only studies conducted in high-income **countries** were included. This is considered because breastfeeding patterns vary widely across countries, depending on income among other factors (see chapter 2.3). The income level of countries is assessed using the current Excel tabulation available from The World Bank (2023). Studies are included if they are written in English or German, and published within the last 10 years as a free full text.

3.3 Information Sources

The literature search is conducted from the 13th February until 17th February 2023 in the following five databases:

- MEDLINE⁷ on the interface PubMed,
- EMBASE⁸ on the interface Elsevier,
- CINAHL⁹ on the interface EBESCOhost,
- WoS¹⁰ on the interface Clarivate Analytics, and
- CENTRAL¹¹.

Additionally, Google Scholar is searched, whereby the first 10 pages (first 100 studies) were taken into consideration for screening. The selection of databases is justified as follows: The first four databases mentioned are searched, because they are among the most important and common for health-related issues (Wöhl et al., 2019, p. 2). It is assumed, that a search of these rather large databases (Wöhl et al., 2019, pp. 7–8) should identify a substantial proportion of the studies relevant to the research question. For example, the bibliographic databases MEDLINE and EMBASE provide a high degree of coverage in topics of medicine and life sciences and contain health and nursing science literature (Wöhl et al., 2019, pp. 7–8). CINAHL is listed in the top list of databases in the field of medicine on the website of the HAW Hamburg (HAW Hamburg, 2023). WoS is the world's leading citation database, containing records of articles from the highest impact journals worldwide (Clarivate, 2021). CENTRAL is a highly concentrated source of reports of randomized and quasi-randomized controlled trials and therefore considered to be suitable for a systematic literature review (Wöhl et al., 2019, p. 7).

3.4 Search Strategy

Based on the research question operationalized and with the help of the customized PICO scheme, a search strategy is developed. For this purpose, synonyms are sought for the main search terms “breastfeeding” and “workplace”. The resulting list of search terms is then steadily extended or shortened. This way, a list of meaningful search terms, targeted to the previously defined research question is designed in a comprehensive process. With the help of these search terms, a combined search is performed, which at first and foremost includes the search by keywords using MeSH (Medical Subject Heading) terms (resp. using Emtree in EMBASE), while the search via text words according to the given search strategy depicted in Figure 12 is considered a complementary and necessary addition. In addition to

⁷ Medical Literature Analysis and Retrieval System Online

⁸ Excerpta Medica Database

⁹ Cumulative Index to Nursing and Allied Health Literature

¹⁰ Web of Science Core Collection

¹¹ Cochrane Central Register of Controlled Trials

keyword search, the text words are searched for in the title and the abstract, and corresponding limitation is made when entering the search terms. The search terms are connected with the Boolean operators “OR” and “AND”, so the basic search looks as depicted in Figure 12.

```
(breastfe* OR "breast fed*" OR "breast feed*" OR lactati*) AND (workplace* OR "work place*" OR worksite* OR "work site*" OR "work-site*" OR "job site*" OR "job-site*" OR "work* location*" OR "work* condition*" OR "return to work" OR "work* environment*" OR "job environment*" OR "work redesign*" OR "job redesign*" OR "work re-entry" OR "job re-entry")
```

Figure 12: Basic search strategy - search terms combined by boolean operators, own figure

A third component could have focused on search words like “intervention, program, or promotion”. However, this component is rather of generic terminology and is therefore rather multilayered and comprehensive. Thus, it would be difficult to determine whether all potentially important terminology has been used. As the search is deemed to become too unspecific by adding this third component, it is decided to use a two-component search strategy. Wöhl et al. (2019, p. 80) even present a blacklist of terms that are too imprecise to be entered into the search mask. Among them, for example, also the terms education, effect, intervention, prevention, program, promotion, or work (Wöhl et al., 2019, p. 80). This confirms the chosen procedure.

As can be seen from Figure 12, use was made of phrase searching (use of quotation marks) to search for word combinations only in the order given. Also, for many terms, a word root search is performed by using truncations (marking with asterisks). Thus, the corresponding term is searched for in the databases with different word endings or with different internal syllables or letters, which usually makes the hit list considerably larger, but appears necessary here in order to include different spellings of a term. The search strategy is adjusted according to the given requirements of the different databases (e.g. different truncation symbols or ways of elimination of MeSh-tree junctions). However, the differences in the practical application will not be discussed in detail here in order not to exceed the scope of this work. Nevertheless, some differences in the application can be seen from the specific individual search histories, which are provided for each database separately in the appendix 1.

The use of limitations during the literature search is used as conservatively as possible, as they seem directly related to reporting bias and the current state of knowledge should not be obscured by their use. The few limitation criteria that are applied are added step by step. If possible, it is narrowed down by publication period, language, and species of human. The justification is described in Chapter 3.2 on eligibility criteria. With these selected filters it is intended to make the search more specific and narrow down the number of results to a manageable amount without excluding relevant hits.

A special case is the search in **Google Scholar** because the requirements are very different from those in one of the databases mentioned above. Google Scholar doesn't take truncations to search for different word endings, but as noted in practice, it is also not possible to include all words with their different endings in the search box, because the number of characters is limited in Google Scholar. Therefore, the search strategy needs to be simplified. This is considered acceptable because the search in Google Scholar is only seen as an addition to the above-mentioned, systematic search strategy in the pertinent databases. Finally, the search strategy illustrated in Figure 13 emerged.

(breastfeed OR breastfeeding OR breastfed OR "breast fed" OR "breast feed" OR "breast feeding" OR "breast feeds" OR lactation OR lactating OR lactational) AND (workplace OR workplaces OR "work place" OR "work places" OR worksite OR worksites OR "work site" OR "work sites" OR "job site" OR "job sites" OR work location OR working location OR work locations OR working locations OR work condition OR working condition OR work conditions OR working conditions OR "return to work" OR "returning to work" OR work environment OR working environment OR job environment OR work redesign OR job redesign OR "work re-entry" OR "job re-entry").

Figure 13: Search strategy applied to Google Scholar, own figure

3.5 Selection Process

For selecting the articles based on the research question and the inclusion criteria, the following procedure for screening is used:

- 1st Removing of duplicates,
- 2nd First screening of the titles and afterward the abstracts, and
- 3rd Screening of the full text of remaining articles.

The articles are reviewed only by one person. Selection is performed based on the eligibility criteria specified in advance (see chapter 3.2) and recorded in a flowchart according to PRISMA guidelines (Page et al., 2021). Thereby, reasons for the exclusion of the articles are documented. In doing so, stating one reason for exclusion is considered enough, even though many studies would fulfill multiple reasons for exclusion (Lefebvre et al., 2022). For organizing the literature in the study selection process, all hits are exported to Excel. A spreadsheet including the articles that emerged from the search is created which should support the process of study selection. The spreadsheet is also used to inform the documentation of the study selection process (see chapter 4.1).

3.6 Data Extraction

For data extraction, it is carefully considered which data is relevant given the focus of the research question and corresponding eligibility criteria of this review. It does not matter whether a variable represents a primary or secondary outcome within the individual study, as long as it is relevant to answer the research question. If besides the variables of interest, other variables are reported in a study that do not fit the eligibility criteria, these are not reported. The following data are extracted in tabular format, which is attached in appendix 2:

- Author, year, and country of publication,
- Characteristics of study participants (incl. sample size), type of worksite, way of recruitment, socio-demographic characteristics, and other determinants of breastfeeding,
- Study design and type of analysis,
- Independent variable of interest, namely type of intervention to promote breastfeeding at the workplace, and
- Outcome variable and statistical results.

In addition to the data extraction table, an overall description of the baseline characteristics of included studies is conducted, with the aim to provide some context to the results section. It is intended to provide a better understanding of the study samples and thereby, special focus is set on the understanding of the distribution of determinants of breastfeeding. This informs the subsequent interpretation of the results and identifies, for example, which confounders have or have not been identified. Nevertheless, not all information from the studies is addressed as detailed information is summarized in the data extraction table (see appendix 2).

3.7 Critical Appraisal

In any systematic review, it is important to assess the methodological quality and risk of bias of the studies included (Dekkers et al., 2019, p. 10), as the results of the critical appraisal provide a basis on which to inform the synthesis and interpretation of the results of the studies (Moola et al., 2020). The tool is selected to be appropriate for the study designs of the included studies (Purssell & McCrae, 2020, pp. 56 & 58). Based on what previous literature shows (see chapter 2.6) and considering predefined eligibility criteria (see chapter 3.2), it is expected that the literature research will yield mainly studies with observational study designs. Also, the previously defined eligibility criteria don't predefine limitations regarding the study design, so different designs could be the result. According to Purssell and McCrae (2020, p. 56), relying on a single tool to evaluate various types of studies may not be accurate. Therefore, it is decided to choose an assessment method that offers a clear and easy-to-understand overview, along with specific tools for different observational study designs. Against this background, the systematic review methodology produced by the

Joanna Briggs Institute (JBI) is chosen, which combines assessment of methodological quality and risk of bias in the design, conduct, and analysis of studies (Moola et al., 2020). The requirement, that all papers selected for inclusion in the systematic review need to be subjected to rigorous appraisal by two critical appraisers (Moola et al., 2020), cannot be fulfilled but is only performed by one person.

The tool is slightly modified for application in this thesis. In terms of content, the indicator questions and response options are not modified, but the form of reporting is. A table is created where each study is in a row and each column a different indicator from the checklist. The resulting study-criterion cell in the table is then colored green (“yes”), red (“no”), or yellow (“unclear”) according to appraisal. The answer option “not applicable” is not listed, as it is simply not used in this assessment, because all indicators are applicable to the studies included. This form of illustration is chosen, instead of numeric scores, as it seems important to consider that each item on the checklist has different implications for the study and the conclusions that can be drawn. Some indicators may be more important than others, and a numeric score cannot accurately represent these factors (Purssell & McCrae, 2020, p. 57). This is considered and additionally, presenting a compressed summary of the results is possible with this approach.

What is also not adopted from the given JBI checklist, is the overall appraisal with the option of including or excluding the study or the option to seek further info. This is done, as for systematic reviews of observational studies, it is advised against excluding studies based on the outcome of the critical appraisal (Dekkers et al., 2019, p. 14), since including all studies and examining the effects of various risks of biases and sensitivity of studies to outcomes in stratified or regression analysis could provide additional insights (Dekkers et al., 2019, p. 14). Due to the decision to include all studies, it is important to clearly distinguish between more and less robust studies (Popay et al., 2006, p. 10). The described critical appraisal process shall inform this distinction. The space for comments in the original JBI checklist is also not adopted, but specific comments on the critical appraisal are provided in text form in addition to the provided table. Finally, the original JBI checklists used can be found in appendix 3, and it is noted, that the explanation of the appraisal tools is attached as well, including concrete descriptions of what is meant by the different indicator questions. During a critical appraisal, only the aspects of a study that are pertinent to the topic of interest are evaluated. This is necessary to note because some studies may investigate multiple variables of which not all are relevant to the thesis, and may use different analysis methods for each.

3.8 Data Synthesis

The eligibility criteria (see chapter 3.2) are not defined in a way that this research focuses on a single, specific exposure and outcome variable. Additionally, there is little commitment to individual statistical methods and study types. This means that it can be expected that the selected studies will be statistically and methodologically heterogeneous, whereas the conduction of meta-analysis is not appropriate (Moola et al., 2020, p. 249). Against this background, the approach of a **narrative synthesis** is considered, which is recommended if no meta-analysis is possible (Moola et al., 2020, p. 249). Additionally, describing and grouping examined variables according to the study characteristics (see chapter 4.2), should help make enough special detail available to determine if included studies are similar enough to be combined in meta-analysis or not.

If conducting narrative synthesis is confirmed by this subgroup analysis, the results are summarized in words and in tables or graphs without statistical analysis to synthesize the results of the studies selected (Moola et al., 2020, p. 244). Nevertheless, to address the research question of which interventions are effective without the conduction of a meta-analysis, the focus is set on whether the study results show a significant association. Therefore, a significance level of alpha less than or equal to .05 is assumed. It is discerned how the evidence is weighted, which is added by linking the results of the certainty assessment, which will be described in the following chapter.

To synthesize the data in a logical manner, a certain structure is determined in advance. It is expected that a textual description of individual studies one by one would exceed the scope of the work and does also not provide an appropriate overview of the results of the research work. Therefore, a textual description of groups of studies is chosen. Meaning, that included studies are sub-grouped based on relevant criteria. The most important aspects of the studies are then summarized in relation to the subgroup in which they are included. Furthermore, differences, and similarities between the studies are outlined. This procedure is also suggested by Moola et al. (2020, p. 244) in a similar way.

For the formation of the subgroups, it is considered what is most likely to be suitable for answering the research question. Since it sets focus on interventions implementable by employers, it is suggested to form subgroups based on the interventions under investigation within the studies. This also means, that individual studies sometimes appear in multiple subgroups with the different interventions they examine. All in all, the narrative synthesis includes the results of the studies, presenting the statistical data extracted from the individual studies in a structured and interconnecting way, including interrelated point and interval estimates that will be reported. These data and summary statistics will be taken as reported from the studies as far as available unless otherwise noted. Links to the sample characteristics are also established. So, in a descriptive manner, systematic and grouped

documentation of the results is created. Study results are compared and similarities or differences are identified.

3.9 Certainty Assessment

“For systematic reviews, the GRADE approach defines the certainty of a body of evidence as the extent to which one can be confident that an estimate of effect or association is close to the quantity of specific interest.” (Schünemann et al., 2022) This approach of the Grades of Recommendation, Assessment, Development and Evaluation Working Group (GRADE Working Group) uses five considerations described by Schünemann et al. (2022) to the assessment of the certainty of the body of evidence for each outcome, making a justification of the body of evidence possible. The more detailed process of assessing the certainty rating is illustrated in Figure 14.

1. Establish initial level of certainty		2. Reasons for considering lowering or raising certainty		3. Final level of certainty rating
Study design	Initial certainty in an estimate of effect	Lower if	Higher if	Certainty is an estimate of effect across those considerations
Randomized trials	High certainty	Risk of bias Inconsistency Indirectness Imprecision Publication bias	Large effect Dose response All plausible Confounding and bias: <ul style="list-style-type: none"> • Would reduce a demonstrated effect or • Would suggest a spurious effect if no effect was observed 	High
				Moderate
Observational studies	Low certainty			Low
				Very low

Figure 14: Levels of the certainty of a body of evidence in the GRADE approach, modified figure according to Schünemann et al., 2022

As described by Schünemann et al. (2022) the GRADE approach specifies four levels of certainty, while the initial rating is categorized according to the type of studies being either randomized trials or non-randomized studies, including observational studies. For instance, for a body of evidence from the latter type of studies, it has to be started with a low-certainty rating. Starting from this initial level, lowering or raising the level of certainty is considered using the five considerations of within- and across-study risk of bias (limitations in study design and execution or methodological quality), inconsistency (or heterogeneity), indirectness of evidence, imprecision of the effect estimates and risk of publication bias, leading to the final certainty level (Schünemann et al., 2022). Again, it is not possible that two people to work independently on the assessment as recommended.

It is stated by Schünemann et al. (2022) that results for outcomes that could not be combined statistically in a meta-analysis (i.e. narrative outcomes), can be entered directly for the single outcomes, without an explanation being necessary to communicate these results. As a narrative synthesis is planned for this review, this does apply. Therefore, the GRADE approach serves only as a rough guideline to conduct certainty assessment, but should not

be justified in every detail. The information needed to inform the certainty assessment will be developed in the results section of this paper (mainly by the performed critical appraisal in chapter 4.3). With the help of the result of the certainty assessment, it shall be possible to rate the quality of the evidence informing the emerging breastfeeding promotion opportunities, respectively what is elaborated on the basis of the results of this review in the discussion to answer the research question.

4 Results

4.1 Study Selection

As underlined by the flowchart in Figure 15, the systematic search in the databases described in chapter 3.4, resulted in 2002 records in total. After this stage of identification, the selection process started by removing 1048 duplicates. The remaining 954 articles were then screened by title and abstract by applying the inclusion and exclusion criteria. 857 articles were excluded resulting in 97 remaining studies eligible for the full text reading. One major reason for the exclusion of the studies was that the studies did not investigate no or other outcomes than those that are of interest for this review ($n^{12}=324$), e.g. only access to workplace breastfeeding support measures is examined, instead of its impact on breastfeeding indicators or studies only publishing prevalence without analyzing associations. Another reason was, that the setting under investigation did not represent a workplace setting ($n=187$), for example sometimes there was no narrowing down by setting at all, but only a particular population (e.g. in a certain community or geographical location) was specified. Often, the articles did not represent a research study, but were published e.g. in form of a practice paper or commentary, or the study design was not suitable, as e.g. many qualitative studies and a few reviews exist ($n=143$). By full-text reading, 84 further studies were excluded, as they are not relevant for answering the research question. Other reasons for exclusion besides the ones already mentioned become visible from Figure 15 and are not described in more detail here to not exceed the scope of the work. Finally, 13 studies were included in the systematic review.

¹² n=number of articles

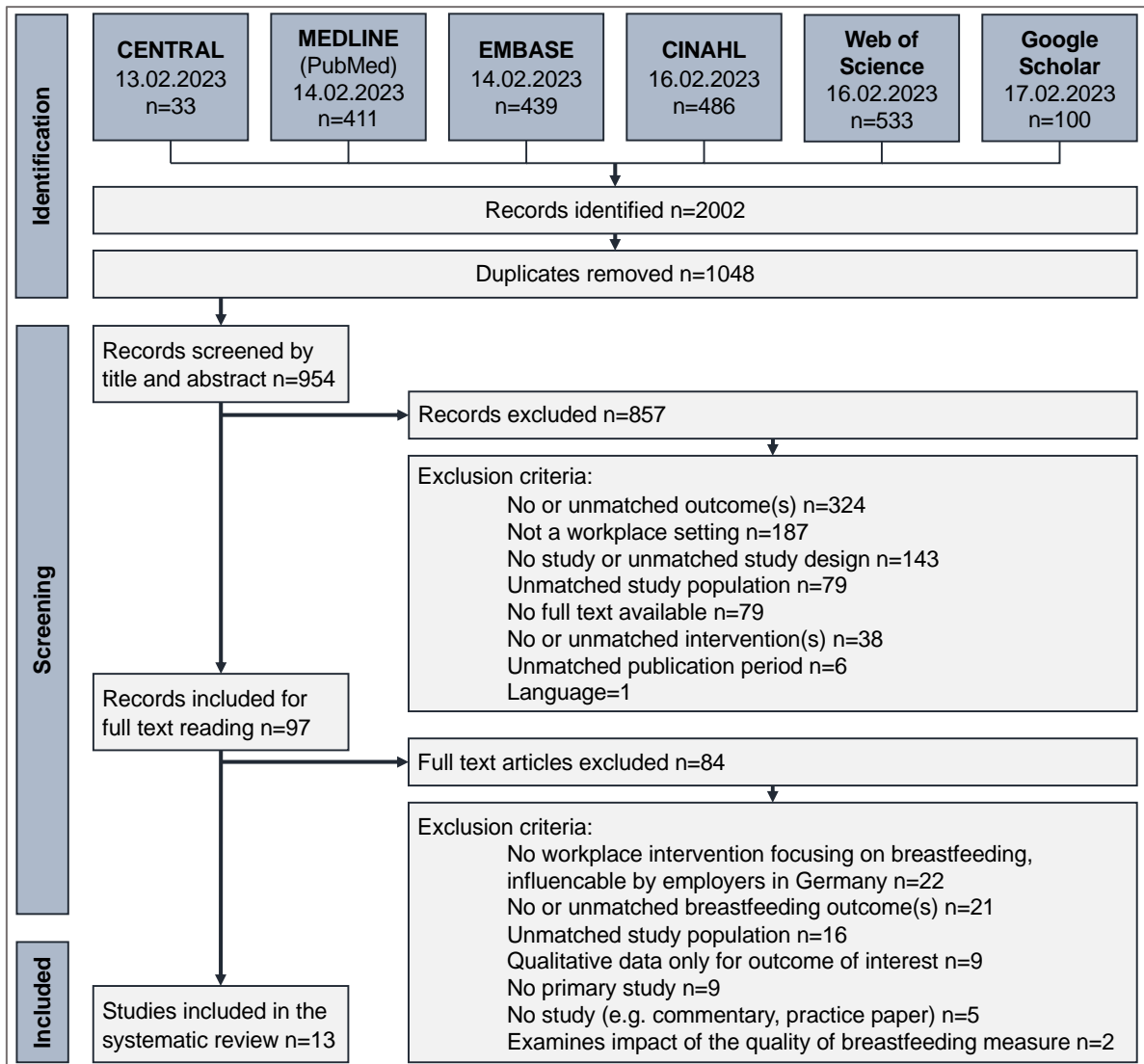


Figure 15: Flow diagram of the study selection process according to the PRISMA 2020 statement (Page et al., 2021)

4.2 Study Characteristics

The basis for this and the following chapters is the table containing the extracted data, including all predefined relevant results and context information extracted from the individual studies included in this systematic review (see appendix 2).

4.2.1 Determinants of Breastfeeding

All of the 13 studies included in this systematic review were published in the English language between April 2013 and February 2023. Most studies are cross-sectional (n=11). Two studies were quasi-experimental (n=1) and case-control studies (n=1). The vast amount of studies were published in the USA (n=7), followed by studies published in China (n=2). Other studies were published in Japan (n=1), Spain (n=1), Australia (n=1), and the United Kingdom (n=1).

The **workplace settings** of participants within the studies are not always reported. If information on this is provided, however, the settings vary. Eight, and therefore most of the studies did not recruit their participants via a specific workplace setting, but used a survey distributed in other ways, for example among women giving birth in a certain hospital (Bai & Wunderlich, 2013; Bono & Pronzato, 2022; Y.-Y. Huang et al., 2023; Kozhimannil et al., 2016; Lauer et al., 2019; Nakada, 2021; J. P. Smith et al., 2013; Spitzmueller et al., 2016). Four of these studies do not report on workplaces the study participants worked at (Y.-Y. Huang et al., 2023; Kozhimannil et al., 2016; Nakada, 2021; Spitzmueller et al., 2016). The other four report on the following institutions (and in part also on the firm size):

- Bai and Wunderlich (2013): educational institutions (31.0%), health care (23.0%), and others (46.1%), e.g. government, media, corporate company, and retail.
- Lauer et al. (2019): accommodation (22.8%), healthcare (25.2%), retail (17.6%), other (34.4%).
- Bono and Pronzato (2022): manager and professional (11.2%), associate professional (16%), administrative and secretarial (22%), skilled trades and personal services (19.5%), sales and customer services (14.7%), plant, machine, and elementary operators (11.5%), missing occupational code (5.1%); firm size in number of employees: 1-24 (34%), 25-499 (41.6%), ≥500 (23.5%), missing (0.8%).
- Smith et al. (2013): Manager professional (62.3%), clerical/administrative, community/personal services, sales workers (37.6%); more specifically: Government administration and defense (30%), education, health, and community services (28%), property and business services (14%), finance and insurance (11%), communication, electricity, gas, and water supply (6%), manufacturing (6%), cultural and recreational services (5%); size: Small with <20 staff (13%), medium with 20-200 staff (39%), large with >200 staff (48%); ownership public (43%), private (57%).

So, in total eight studies include participants from diverse work settings. Among other things, the job background also provides clues to the possible **socioeconomic status**. A rough estimation of this status for the included studies should be provided. Therefore, information available from the included studies is used, including the main indicators income-level, educational level, and type of workplace, but also WIC participation and the way of recruitment were considered. This judgment is limited since not all information is available to the same extent within the studies. For example, information on educational status is mostly provided, whereas information on income level is often missing. Nevertheless, the following Table 3 shows the subjectively determined result based on these indicators.

Lower SES ¹³	Lower to average SES	Average SES	Average to higher SES	Higher SES
Lauer et al. (2019)	Tsai (2013)	Bono & Pronzato (2022)	Smith et al. (2013)	Alvarez et al., (2015)
-	-	Huang et al., (2023)	Nakada (2021)	Cervera-Gasch et al. (2021)
-	-	Kozhimannil et al., (2016)	-	Melnitchouk et al. (2018)
-	-	Spitzmueller et al., (2016)	-	Sattari et al. (2013)
-	-	-	-	Bai & Wunderlich (2013)

Table 3: Categorization of studies according to estimated socio-economic status of study samples, own table

Within many of these studies (Bono & Pronzato, 2022; Huang et al., 2023; Kozhimannil et al., 2016; Spitzmueller et al., 2016) a fairly average socioeconomic status can be expected, as due to the method of selection of participants it is more likely to reach a broad range of people involving different socioeconomic groups. Looking at the educational or income levels stated within the studies, the assumption is confirmed. However on this basis, in some studies, the socio-economic status can even be estimated as average to high (Nakada, 2021; J. P. Smith et al., 2013). Yet, this cannot be applied to the study of Lauer et al. (2019), who recruited women participating in the WIC program, as it is a program for families in the lower income level (California Department of Public Health, 2023). In the study of Tsai (2013), recruiting participants from an electronics manufacturing company, including clean room and office workers, is expected to be located in a socio-economic group classified as lower to average level. Furthermore, three studies focus on the study sample of employees in the university setting and one study investigates physicians working in different practices (Alvarez et al., 2015; A. Cervera-Gasch et al., 2021; Melnitchouk et al., 2018; Sattari et al., 2013). It is estimated that these four studies place focus on the population group with a higher socio-economic status. The study sample of Bai and Wunderlich (2013) is also assigned to this group. The survey was conducted with employees of a higher education institution and clients of an obstetric hospital in New Jersey, and it is stated that mothers in this study are highly educated, with many of them having private offices (Bai & Wunderlich, 2013, pp. 690 & 693).

It becomes apparent that the addressed study samples represent heterogenous groups with different socio-economic backgrounds. However, it is also clear that the socio-economic status tends to be high on average between the study samples. This becomes clear as in comparison a low proportion of studies (n=2) are classified as lower or lower to average socio-economic status, while all others (n=11) have an average or higher, and among these even five study samples are classified as higher socio-economic status.

¹³ Socioeconomic status

In terms of **maternal age**, all studies investigate only adult mothers, except for Lauer et al. (2019). However, in this study women aged 15 to 17 only represent 0.6% of the study sample. When comparing the means and the categorized age groups given, it becomes apparent that the mean age is often around or slightly over 30 and mostly under 35, or categories that include this age group are often the largest. With few exceptions, this is consistently observed in the studies. Notably, exceptions are the study of Sattari et al. (2013) with a rather high average age of 37.6 years, and the study of Huang et al. (2023) with a rather low average age of 26.2 years reported. However, in some studies, no such inferences can be drawn, e.g. in one study (A. Cervera-Gasch et al., 2021) no description regarding age is given. In Lauer et al. (2019) it is unclear whether the study sample might also be more likely to be younger, as one category includes all ages from 18 to 34, and no mean is reported. Furthermore, if reported within a study (n=6), most participants were **married** or in a relationship (usually more than 80%).

The distribution of **parity** is very diverse among studies that report on this determinant (n=9). Some studies include only mothers with one child, in order to avoid bias (Alvarez et al., 2015; Spitzmueller et al., 2016). In four studies, the study sample includes more women who have given birth only once (Bai & Wunderlich, 2013; Bono & Pronzato, 2022; Y.-Y. Huang et al., 2023; Nakada, 2021). Furthermore, in three studies multiparity is reported more often (A. Cervera-Gasch et al., 2021; Melnitchouk et al., 2018; Sattari et al., 2013). Four other studies don't report on parity (Kozhimannil et al., 2016; Lauer et al., 2019; J. P. Smith et al., 2013; Tsai, 2013). Four studies report on the **mode of delivery**, with all of them having more participants with a vaginal birth (about 70-90%) than a cesarean section (about 10-30%) (Bono & Pronzato, 2022; A. Cervera-Gasch et al., 2021; Y.-Y. Huang et al., 2023; Kozhimannil et al., 2016).

Five studies report on the **work status** of either working full- or part-time or on daily working hours: In Bai and Wunderlich (2013) and Nakada (2021) more than 70% and therefore most women work full-time. This is different from the study of Lauer et al. (2019), in which about the same amount of women work full-time, as part-time (Lauer et al., 2019, p. 5). In Alvarez et al. (2015) the number of women working full-time postpartum is lower, comprising 23%. The participants of the study by Tsai (2013) state either working 8 hours per day (about 16%) or working 9-14 hours per day (about 83%), which therefore is both counted as full-time or even more than a usual full-time job. Within the same study, about 47% of women are doing shift work. Other studies do not report on the work status. However, Huang et al. (2023) doesn't report on this, because only full-time employed women are included in the study.

The impact of **maternity leave**, its length, and whether it is paid or unpaid is under study in some of the included articles. In other studies, however, data on this are also obtained as

background knowledge about the study sample. Three studies provide information on this. The average length of general (also unpaid) maternity leave is 11.4 weeks in the study of Alvarez et al. (2015), conducted in the USA, and much longer in the study of Huang et al. (2023), conducted in China, with 5.3 months on average. The average duration of paid maternity leave in the study sample of Alvarez et al. (2015) is much shorter with a mean duration of 6.3 weeks. Also in the study by Cervera-Gasch et al. (2021), conducted in Spain, the majority of study participants (nearly 60%) report longer maternity leave of more than 16 weeks; approximately one-quarter report 12-16 weeks as the duration, and under 8% report less than 12 weeks. It becomes clear that the duration of maternity leave can vary greatly depending on the country. At this point, the individual legal bases of the individual countries will not be presented in a differentiated manner, as these are in part very complex, can vary by city, or can depend on other factors such as the employer (International Labour Organization, 2023). For example, in the USA the specified duration of maternity leave only applies if parents work for a company with 50 or more employees (Department of Labor United States of America, 2023). However, in exemplary format, brief information should be provided with regard to regulations in the USA, as most studies within this review are conducted in this country (see above). In this country, there is a general law, namely the Family and Medical Leave Act of 1993, that entitles to 12 weeks of unpaid parental leave per annum (Department of Labor United States of America, 2023). It is further noted, that the internationally recommended minimum parental leave rate by the International Labor Organization (more accurate of the ILO Maternity Protection Convention, 2000, No. 183, article 4) comprise 14 weeks (International Labour Organization, 2000). So, the United States has not passed this recommendation to offer paid maternity leave to their employees.

Smoking status is reported by two studies, with very different specifications. In the study of Nakada (2021) all participants smoked in the program and pamphlet group, while 98% smoked in the comparison group. In contrast, 10% of women in the study sample in Bono and Pronzato (2022) stated having smoked in. The study of Kozhimannil et al. (2016) furthermore describe how many babies were in neonatal intensive care unit, representing about 20% within this study sample. Regarding the **infants' health status**, Huang et al. (2023) specifies that only mothers of healthy newborns are included in the study. The two studies examining physicians further report the **specialty type** of the women included in the studies. It did not differ so much between the studies, with 35.4% being surgical (and 64.6% being non-surgical) in the study of Sattari et al. (2013) and 27.8% being surgical (and 72.2% being non-surgical) in the study of Melnitchouk et al. (2018).

4.2.2 Variables and Statistical Methods

Table 4 provides a summary of the study characteristics of statistical methods used and outcome variables examined. With regard to statistical analysis, three studies used Spearman's correlations, also three studies used multivariate logistic regression, and one study used simple logistic regression. One study conducted analysis by multiple linear regression and two by survival analysis, whereby one of these made use of the Cox proportional hazards regression and the other comprised multivariate Cox proportional hazards ratios. A multivariate mixed linear model is also conducted by one single study, whereas the Chi-square test with Fisher's correction whenever necessary is applied by four studies. Which of the studies uses which analysis method is shown in Table 4.

The endpoints investigated within all of the 13 studies always refer to a breastfeeding indicator with a time reference. Sometimes exclusive breastfeeding is investigated (n=5), but more often any breastfeeding is (n=11). Some studies report on the duration of exclusive or any breastfeeding, some investigate whether breastfeeding was continued for a certain duration (e.g. for three, four, six or twelve months) or not. In more detail, the outcomes investigated within the individual studies are illustrated in Table 4.

Author, year	Correlations	(Multivariate) logistic regression	Multiple linear regression	Survival analysis	Multivariate mixed linear model	Chi-square test/ Fisher's exact test
Alvarez et al., 2015	EBF duration and any BF duration	-	-	-	-	-
Bai & Wunderlich, 2013	EBF duration	-	-	-	-	-
Bono & Pronzato, 2022	Any BF at 4 M. and at 6 M. postpartum	-	-	-	-	-
Cervera-Gasch et al., 2020	-	-	-	-	-	Continuation of any BF after RTW and any BF duration for <6 M., 6-12 M., 1-2 years, >2 years postpartum and currently BF
Huang et al., 2023	-	-	Any BF duration	-	-	-
Kozhimannil et al., 2016	-	EBF for 6 M. and any BF at 6 M. postpartum	-	Hazard ratio of EBF and BF	-	-
Lauer, 2019	-	-	-	-	-	Any BF duration for ≥4 M. and <4 M. postpartum
Melnitchouk et al., 2018	-	Any BF for ≥12 M. postpartum and to personal goal	-	-	-	-

Author, year	Correlations	(Multivariate) logistic regression	Multiple linear regression	Survival analysis	Multivariate mixed linear model	Chi-square test/ Fisher's exact test
Nakada, 2021	-	Any BF 3 M. after RTW	-	-	-	Any BF 3 M. after RTW
Sattari et al., 2013	-	-	-	-	Any BF duration	-
Smith et al., 2013	-	-	-	-	-	EBF at 6 M. postpartum
Spitzmueller et al., 2016	-	-	-	Any BF during first 12 M. and EBF duration within first 6 M. postpartum	-	-
Tsai, 2013	-	Continuation of any BF 1-6 and >6 M. after RTW	-	-	-	-

Notes: EBF=exclusive breastfeeding; BF=breastfeeding; M=months; RTW=return to work

Table 4: Heterogeneity of included studies in terms of statistical methods and outcome variables used, own table

Considering the previous chapter, the characteristics of the study samples of the articles included in part seem to be quite heterogeneous. Simultaneously, as just described, included studies seem to be of high heterogeneity in terms of statistical and methodological approaches, as already expected (see chapter 3.8). This, and thus the decision not to conduct a meta-analysis (Moola et al., 2020, p. 249), is underpinned by the aid of Table 4. The analysis strategies are listed in the header line, so based on the fields that are filled, it is then possible to see which of the statistical methods are used in the respective study. At the same time, the filled field contains the outcome variable that was investigated in the study by the corresponding statistical method. This way, it easily becomes apparent which studies have used the same statistical method. By then comparing the outcomes listed in each column, it can be determined whether the outcome variables detected by the same statistical method are comparable or whether they are heterogeneous. By doing so, it becomes clear that heterogeneity is very present. Some studies are the only ones with their statistical analysis method used, whereas those that have matching analysis methods don't investigate the same outcomes. Merely the studies of Bai and Wunderlich (2013) and Alvarez et al. (2015) investigate the same outcome, namely the duration of exclusive breastfeeding, using Spearman correlations. Therefore, for these two studies, the exposures that are subject of the studies, are compared. When looking at the exact independent variables and how they were measured, only the variable "break time" is comparable (see Table 5). In conclusion, as overall the studies are intensely heterogeneous, the decision in this review not to perform a meta-analysis remains.

Author, year	Break times	Space/room for breast-feeding	Single utility items	Supervisor/ coworker support	Work-place policy	Combined interventions
Alvarez et al., 2015	X	X		X		
Bai & Wunderlich, 2013	X	(X)	(X)	(X)	X	X
Bono & Pronzato, 2022	X	X				
Cervera-Gasch et al., 2020						X
Huang et al., 2023	(X)	(X)	(X)	(X)		X
Kozhimannil et al., 2016	X	X				X
Lauer, 2019	X	X	X	X	X	
Melnitchouk et al., 2018	X	X				
Nakada 2021						X
Sattari et al., 2013	X			X		
Smith et al., 2013	X			X	X	
Spitzmueller et al., 2016	X	X	X	X		
Tsai, 2013	X	X		X		

Table 5: Summary of independent variables reported in included studies, own table

This is also confirmed by looking at Table 5, in which the independent variables that are covered within the different studies are depicted, being broadly categorized under collective headings. The table shows which interventions are studied by the different individual articles. However, combined interventions comprise different combinations, as well as single utility items are diverse. What specifically is being studied will become clear in chapter 4.5. The crosses which are in parentheses indicate that although the corresponding category was the subject of the research, it was not studied individually, but in combination with other factors.

4.3 Critical Appraisal

Cross-sectional Studies

Most studies (n=11) are of cross-sectional design, in which the exposure and outcome are measured in the sample at the same time (Setia, 2016), which holds different benefits and downsides. Wang and Cheng (2020, p. S 67) describe that benefits are rather of practical type, as studies of this design are quick, inexpensive to conduct, and usually no ethical difficulties arise. At the same time, multiple outcomes and exposures can be studied, so it provides an easy way to generate hypotheses and the design is suitable if findings should be used to create an in-depth research study. However, it is assumed that one of the largest downsides is that it is relatively difficult to establish causal relationships and associations detected might be difficult to interpret. Simultaneously, it is not possible to investigate the temporal relation between outcomes and exposures. In addition, studies of this design are susceptible to biases such as selection bias due to nonresponse and recall bias, as predictor measurements mainly rely on retrospective self-report (Wang & Cheng, 2020, p. S 67). From this can be derived, that there is a number of limitations applicable to all studies included in this review that are of this type of study design. In order to inform the result of the

critical appraisal for the individual studies depicted in Figure 16, the reasons for the fields marked red are described below.

Study (year, author)	1.	2.	3.	4.	5.	6.	7.	8.
Bai & Wunderlich, 2013								
Kozhimannil et al., 2016								
Alvarez et al., 2015								
Tsai, 2013								
Lauer et al., 2019								
Sattari et al., 2013								
Huang et al., 2023								
Melnitchouk et al., 2018								
Spitzmueller et al., 2016								
Bono & Pronzato, 2022								
Smith et al., 2013								
1. Were the criteria for inclusion in the sample clearly defined? 2. Were the study subjects and the setting described in detail? 3. Was the exposure measured in a valid and reliable way? 4. Were objective, standard criteria used for measurement of the condition? 5. Were confounding factors identified? 6. Were strategies to deal with confounding factors stated? 7. Were the outcomes measured in a valid and reliable way? 8. Was appropriate statistical analysis used?								
Key								
Yes								
no								
unclear								

Figure 16: Critical appraisal of cross-sectional studies, own figure

With regard to **indicator one**, in the study of Lauer et al. (2019), the eligibility criteria are not limited to working women in the first place. In addition, the criteria for inclusion in the sample are not very specific. For example, also breastfeeding status or having a child is not considered at this stage in the study (Lauer et al., 2019). Moreover, generalizability of the study findings is difficult due to the fact, that in many studies, the baseline data reported within the studies often lack information on study subjects and workplace settings (see **indicator two** in Figure 16). To further inform this indicator of the critical appraisal, it is evaluated to which degree individual determinants of breastfeeding behavior (see chapter 2.3.3) are included in the description of the sample characteristics (e.g. income, education, age, workplace setting and status, parity, mode of delivery or smoking status). In nine of eleven studies, it was observed that important covariates were not recorded. This relates for example to those omitting information on workplace setting (Y.-Y. Huang et al., 2023; Kozhimannil et al., 2016; Spitzmueller et al., 2016), educational level and/or income (Y.-Y. Huang et al., 2023; Lauer et al., 2019; Tsai, 2013) or work status (Bono & Pronzato, 2022; Kozhimannil et al., 2016; Melnitchouk et al., 2018; Sattari et al., 2013; J. P. Smith et al., 2013; Spitzmueller et al., 2016). All of these studies also did not report on several other characteristics which, however, were considered not as important as those previously mentioned, including for example parity, mode of delivery, (paid or unpaid) maternity leave length, smoking, and/or health status of the infant. None of the eleven studies report on all

of the mentioned variables. Nevertheless, two studies were evaluated as fulfilling indicator two (Alvarez et al., 2015; Bai & Wunderlich, 2013), because the variables considered most relevant are mentioned: Age, income level, educational level, workplace setting, parity, and work status are reported by Bai and Wunderlich (2013). Except for income and educational level, the same variables are also covered in Alvarez et al. (2015), but as only lawyers are included, income and educational level are not considered important information to establish comparability; in addition, information on (paid) maternity leave length is provided. So, within the individual studies, the samples are in part quite homogenous population groups, also related to subjective and setting-related characteristics. At the same time, between studies, the samples are quite heterogenous, and therefore difficult to compare. For example, they relate to different income classes; and many characteristics are at the same time not described in sufficient detail by the vast amount of studies. With regard to **indicator three**, in the study of Melnitchouk et al. (2018) the exact questions and answer options used are not mentioned, which could influence reliability.

Indicator five of the critical appraisal is closely related to indicator two because already mentioned determinants influencing breastfeeding behavior, might act as potential confounders. Referring only to the variables mentioned above (among indicator two), no study reports on all of these variables. This is why the judgment is made that no study could identify confounders in a sufficient and comprehensive way. Strategies to deal with confounding factors (**indicator 6**) were stated and performed in the study of Bai and Wunderlich (2013) in the form of subgroup analysis for some covariates. However, this was not done for all relevant covariates that were reported, such as educational level. Also, a proper comparison between workplaces was not possible due to the rather small sample size. In the study of Smith et al. (2013), the issue of not addressing possible confounding factors and strategies to deal with them (unadjusted analysis is conducted only), is also very present. In the study of Alvarez et al., (2015) confounding factors are identified for those baseline characteristics collected (even if variables like mode of delivery and smoking status are missing); however, no strategies to deal with these are applied. Also, no strategies to deal with confounding were mentioned in the study of Lauer et al. (2019). In the study of Huang et al. (2023), it remains unclear whether the few confounding factors that were identified were properly considered in the analysis. Indeed, no specific strategies are described for dealing with confounders. However, multiple linear regression analysis is conducted, which provides a way of accounting for potentially confounding variables that have been included in the model, since the association between a given independent variable and the outcome can be estimated holding all other variables constant (Boston University School of Public Health, 2013). Therefore, the criterion is rated “unclear” in the critical appraisal.

For **indicator seven**, all studies are colored red, which is related to the fact that all articles study outcome variables that focus on some sort of self-reported breastfeeding duration. So, participants might have (in part even retrospectively) given answers in a way that they would have desired, rather than stating the actual breastfeeding duration. This confirms existing recall bias, accompanied by social desirability and memory bias. The risk of over- or under-reporting is increased, and objectivity is compromised. Additionally, it is not sure, whether in all studies validated instruments are used, which can impact outcome assessment validity. For example, Melnitchouk et al. (2018) do not provide information on the exact answer options, so it is unclear whether the measurement tool used is valid. Also, in the study of Lauer et al. (2019), it remains unclear how exactly the outcome of “breastfeeding duration” was measured. It is not clear whether it was originally collected in the form of a categorical or continuous variable, and how exactly the question was posed (Lauer et al., 2019). This could influence reliability.

This also results in the rating for **indicator eight** on whether appropriate statistical analysis was used. It is rated “unclear” in the study of Lauer et al. (2019), because if the outcome was collected as a continuous variable, other analysis methods such as correlations could have been more meaningful. Additionally, assumptions associated with the analytical approach are not apparent. It is not justified why breastfeeding duration was measured by comparing breastfeeding for four months or longer with breastfeeding for less than four months. This information (breastfeeding for four months) does not correspond to the recommended duration of breastfeeding by the WHO (see chapter 2.3.1).

Furthermore, it shall be noted, that in many studies, the sample was selected based on a specific workplace setting (Alvarez et al., 2015; Bai & Wunderlich, 2013; Sattari et al., 2013; Tsai, 2013), which might result in issues with self-selection. For instance, the availability of workplace accommodations for breastfeeding may influence women’s decision to return to work, or women who are more intent on breastfeeding may select a workplace with more generous accommodations for breastfeeding. Further, the samples of a particular occupational setting consist of a specific group of participants, so the results of these are assumed not to be representative of the general population¹⁴, which limits interpretability. In short: selection bias is assumed. In addition to the four studies mentioned above, this also relates to the study of Melnitchouk et al. (2018) in which only physicians were recruited via a specific group on social media. As an example, the low breastfeeding continuation rates of physician mothers seem to be associated with their occupation and represent a distinct group of mothers that seem to be at high risk for premature breastfeeding cessation (Alvarez et al., 2015, p. 2). In addition to the previous appraisal, it should be noted that in

¹⁴ Relates to average population of breastfeeding working mothers here

the study of Smith et al. (2013) the results were described as significant even if the p-value was greater than .05. Even if this is corrected for the results reported within this review, the misinterpretation of the p-value is seen as an indicator of a serious quality deficit within the study.

Quasi-experimental Studies

“Quasi-experimental studies evaluate the association between an intervention and an outcome using experiments in which the intervention is not randomly assigned.” (Schweizer et al., 2016, p. 1) According to Schweizer et al. (2016, p. 2), advantages of this study type are, that they are less expensive in conduction compared to randomized controlled trials and it is an appropriate design, when randomization is not possible or unethical. Additionally, real-world effectiveness of an intervention can be measured better, rather than measuring efficacy of an intervention implemented by research staff under research conditions. So, quasi-experimental studies are pragmatic and may therefore be more generalizable and have better external validity than randomized controlled trials. At the same time, the fact that randomization is not used, represents the greatest disadvantage, as it limits the ability to conclude a causal association between the intervention and outcome measured. Another point are biases that may occur, leading to a loss of internal validity. Especially selection bias often is an issue in which the intervention group may differ from the baseline group. However, also reporting bias is prevalent in retrospective quasi-experimental studies, as researchers may only publish studies with positive findings or do simply not publish null or negative findings (Schweizer et al., 2016, p. 2).

Study (year, author)	1.	2.	3.	4.	5.	6.	7.	8.	9.
Nakada, 2021									
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)? 2. Were the participants included in any comparisons similar? 3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest? 4. Was there a control group? 5. Were there multiple measurements of the outcome both pre and post the intervention/exposure? 6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed? 7. Were the outcomes of participants included in any comparisons measured in the same way? 8. Were outcomes measured in a reliable way? 9. Was appropriate statistical analysis used?									
Key									
Yes									
no									
unclear									

Figure 17: Critical appraisal of quasi-experimental studies, own figure

As apparent from Figure 17, in the study of Nakada (2021) one indicator is marked red, as no multiple measurements of the outcome exist pre and post intervention. Instead, only participants with the outcome (only breastfeeding women) are included in the study, and measurement of the outcome (continuing breastfeeding) post intervention is only conducted at a single time point. Therefore, it is not possible to explore the changes of the effect in time in each group and to compare these changes across the groups. This lack of temporality limits the ability to conclude a causal relationship (Schweizer et al., 2016, p. 7).

Case-control Studies

According to Tenny et al. (2023), a case-control study compares two groups of people: those with the condition under study (cases) and a similar group who do not have the condition (controls). The histories of the people in each group are then studied to learn what factors may be associated with the condition. This type of study allows for studying rare diseases and makes it possible to look at multiple exposures at once, which is also why it represents a helpful study design to build initial evidence of an association between exposure and an outcome. A common disadvantage within this study type is the potential for recall bias, as due to subjects' imperfect memories of past exposures, the likelihood of reporting exposures is higher in the case group than in the control group, whereas recall bias may lead to concluding that there are associations between exposure and outcome that in fact do not exist. Furthermore, case-control studies can be used to establish a correlation between exposures and outcomes, but cannot establish causation. After all, finding an appropriate control group with almost the same characteristics as the case group, and recognizing the potential for failing to identify confounding variables or exposures, is a challenge when conducting case-control studies (Tenny et al., 2023).

Study (year, author)	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Cervara-Gasch et al., 2020										
1. Where the groups comparable other than the presence of disease in cases or the absence of disease in controls? 2. Were cases and controls matched appropriately? 3. Were the same criteria used for identification of cases and controls? 4. Was exposure measured in a standard, valid and reliable way? 5. Was exposure measured in the same way for cases and controls? 6. Were confounding factors identified? 7. Were strategies to deal with confounding factors stated? 8. Were outcomes assessed in a standard, valid and reliable way for cases and controls? 9. Was the exposure period of interest long enough to be meaningful? 10. Was appropriate statistical analysis used?										
Key										
Yes										
no										
unclear										

Figure 18: Critical appraisal of case-control studies, own figure

Besides these general limitations due to the study design (e.g. memory or recall bias due to retrospectivity), of the study of Cervera-Gasch et al. (2020), the indicator fields in Figure 18 were nearly all colored green. However, some important characteristics that could be potential confounding factors were not assessed and therefore not identified, including age, income level, work status, smoking status, and health status. Another factor that can be added as a limitation of the study is, that participation was voluntary. Even though the response rate was acceptable, it was not very high and perhaps the most extreme opinions are represented in the study for this reason, as those women who had excellent or bad experiences could have felt more motivated to participate in the study. This confirms the above-mentioned recall bias.

4.4 Certainty Assessment

Even though it is not necessary to justify the results of the certainty assessment (see chapter 3.9), a brief description of how the rating for the individual outcomes was arrived at shall be provided. Considering all cross-sectional studies included in this review, level of certainty is rated as low initially due to the observational study design (see chapter 3.9). In the next step, it is considered to even lower the level of certainty for all outcomes investigated within these studies. Based on the critical appraisal (see chapter 4.3), it is assumed that there is plausible bias in all studies, that weakens confidence in results and might affect interpretation. Additionally, heterogeneity within studies is high (see chapters 4.2 and 4.3), whereas inconsistency is present, which limits the ability to derive profound, synthesized results applicable to the general population. Additional factors that are present in some cases, e.g. with regard to imprecision (see chapter 4.3), even reinforce the decision to downgrade the level of certainty. So overall, even if some studies are of slightly better quality than others, the certainty of the evidence is **rated “very low“ for all outcomes of the cross-sectional studies** within this systematic review.

As the quasi-experimental study by Nakada (2021) is nonrandomized, the initial level of certainty of the evidence is rated low for the outcomes investigated. It is considered to stay with this rating, as it is assumed that described limitations (see chapter 4.3) are unlikely to lower confidence in the estimate of effect. The same applies to the nonrandomized (case-control) study by Cervera-Gasch et al. (2020). It is decided to stay with a low rating of the level of certainty of the evidence as it is assumed that described limitations (see chapter 4.3) are rather unlikely to lower confidence in the estimate of effect. Therefore, the **outcomes of the study of quasi-experimental design and of the case control study are rated as of “low”** certainty of evidence.

4.5 Narrative Synthesis

Since the synthesis of the results should be structured in subgroups according to the interventions studied, Table 5 in chapter 4.2.2, providing an overview of the different interventions reported in each of the studies, provides insight into the structure of this chapter in terms of comprised sub-chapters and included studies. Within these sub-chapters, additional subdivisions are made according to the endpoints of either exclusive or any breastfeeding. However, a joint consideration is also provided.

4.5.1 Break Time

The determinant factor that most studies included in the review (n=10) address as a single dimension under investigation, is break time for breastfeeding. How the determinant break time is measured differs. Some studies examine the impact of the general availability of break time. However, often the impact of the availability of break time perceived as adequate is investigated. In some studies, additional precision is provided by highlighting the possibility to take long and frequent enough breaks, flexibility of these, and/or coworker support to take them. Another study makes a difference between being aware of available break times and making use of these.

Study	Outcome variable	Independent variable		DoA	CoE
		Significant	Not significant		
1.	Duration of exclusive breastfeeding	Sufficient break time		(+)	Very low
2.	Exclusive breastfeeding duration		Break time, including frequency and duration of break times, flexibility of these and coworker support to take them.	(+)	Very low
3.	Exclusive breastfeeding at six months	Sufficient break time		(+)	Very low
	Continuation of exclusive breastfeeding		Sufficient break time		
4.	Exclusive breastfeeding at six months of infant's age		Possibility to take long enough, or frequent enough, breastfeeding breaks	(+)	Very low
5.	Duration of exclusive breastfeeding during the first 6 months of the infant's life		Sufficient break time	(+)	Very low

Note:
 1. Alvarez et al., (2015), USA
 2. Bai and Wunderlich (2013), USA
 3. Kozhimannil et al. (2016), USA
 4. Smith et al. (2013), Australia
 5. Spitzmueller et al. (2016), USA
 DoA=Direction of association, illustrated by (+) for a positive and (-) for a negative association;
 CoE= Level of certainty of the evidence for each outcome, ranging from very low, to low, moderate or high.

Table 6: Studies investigating the association of break time on exclusive breastfeeding outcomes, own table

Out of the ten studies, five investigate some sort of outcome variable focused on **exclusive breastfeeding** (duration and at six months). They are displayed in Table 6. Two of the studies showed a significant result for the impact of break time on exclusive breastfeeding.

Alvarez et al., (2015) found a positive and significant correlation, with high effect size, between sufficient time at work for breastfeeding breaks and duration of exclusive breastfeeding ($r(27)=.462$, $p=.030$) among 29 female lawyers in the USA with only one child mainly working part-time at a university. The results of the study of Kozhimannil et al. (2016) show, that women of on average moderate socioeconomic status with sufficient break time were 2.59 times as likely to breastfeed exclusively (95% CI: 1.00–6.71, $p<.05$) at six months postpartum compared with women without access to break time or private space. However, the hazard ratio of continuation of exclusive breastfeeding doesn't show a significant relationship with having reasonable break time for breastfeeding.

Results of other studies contradict these findings. Bai and Wunderlich (2013) detect no significant correlation between break time, including frequency and duration of break times, the flexibility of these and coworker support to take them, and the duration of exclusive breastfeeding, $p=.52$. This study includes participants of higher socioeconomic status and most women work full-time and have only one child. Also, no significant relationship was found in the study of Smith et al. (2013), including a sample of women with average to higher socioeconomic status, between the possibility to take long enough, or frequent enough, breastfeeding breaks and exclusive breastfeeding at six months of infant's age, $p=.077$. Furthermore, in the study of Spitzmueller et al. (2016) including a sample of women belonging to an average socioeconomic status, a relationship between the availability of break time and exclusive breastfeeding during the first six months postpartum was not detected ($B=-0.01$, Wald=0.00, $p=.96$).

In summary, two studies, comprising a sample of 579 participants in summary, find a significant association between the availability of sufficient break time on exclusive breastfeeding outcomes. Of these, however, one comprises a very small sample size with $N=29$ (Alvarez et al., 2015), and the other uses two different analysis methods whose results are contradicting (Kozhimannil et al., 2016). So, there is little amount and weight of evidence for the association of available (appropriate) break times on exclusive breastfeeding outcomes. Level of certainty is rated as very low for all outcomes.

4 Results

Study	Outcome variable	Independent variable		DoA	CoE
		Significant	Not significant		
1.	Duration of any breastfeeding	Sufficient break time		(+)	Very low
2.	Any breastfeeding at four months postpartum		Availability of extended breaks	(+)	Very low
	Any breastfeeding at six months postpartum				
3.	Any breastfeeding at six months	Sufficient break time		(+)	Very low
	Continuation of any breastfeeding		Sufficient break time		
4.	Any breastfeeding four months or longer	Availability of break time for breastfeeding		(+)	Very low
			Flexibility of those break times		
5.	Pumping to personal goal	Having a schedule accommodating for pumping		(+)	Very low
	Any breastfeeding for 12 months or longer				
6.	Any breastfeeding duration	Availability of time at work for milk expression		(+)	Very low
7.	Duration of continuation of any breastfeeding during the first 12 months of the infant's life		Availability of break time	(+)	Very low
8.	Continuation of any breastfeeding during the first six months after returning to work	Making use of breastfeeding breaks		(+)	Very low
			Being aware of breastfeeding breaks		
	Continuation of any breastfeeding for more than 6 months after returning to work	Making use of breastfeeding breaks			
			Being aware of breastfeeding breaks		

Note:
1. Alvarez et al., (2015), USA
2. Bono and Pronzato (2022), UK
3. Kozhimannil et al. (2016), USA
4. Lauer et al. (2019), USA
5. Melnitchouk et al. (2018), USA
6. Sattari et al. (2013), USA
7. Spitzmueller et al. (2016), USA
8. Tsai (2013), China
DoA=Direction of association, illustrated by (+) for a positive and (-) for a negative association;
CoE= Level of certainty of the evidence for each outcome, ranging from very low, to low, moderate or high.

Table 7: Studies investigating the association of break time on outcomes related to any breastfeeding, own table

As can be seen from Table 7, with regard to the studies (n=8) investigating outcome variables that examine **any breastfeeding or pumping breastmilk to personal goal** in some way, two show no significant association at all, while six studies do show significant results regarding break times having a positive impact on any breastfeeding. Among those are three studies whose study samples are assigned here to higher socioeconomic status, detecting significant associations with regard to the availability of sufficient break time or a suitable work schedule (Alvarez et al., 2015; Melnitchouk et al., 2018; Sattari et al., 2013). They do not show contradictory results within the studies. In more detail, for any breastfeeding, Alvarez et al., (2015) found a positive and significant correlation of high effect size

between sufficient time at work for breastfeeding breaks and the duration of any breastfeeding ($r(27)=.493$, $p=.044$). Sattari et al. (2013) detected that each increase in score in reported availability of time at work for milk expression was associated with a 1.1-month ($r=0.29$, $p<.0001$) increase in breastfeeding duration among physician mothers working at academic institutions, the size of effect being medium. As stated by Melnitchouk et al. (2018), having a schedule that accommodated pumping is associated with increased odds of breastfeeding to at least 12 months postpartum (odds ratio (OR)=1.58, 95% CI, 1.26-1.98, $p<.001$) and with breastfeeding to personal goal (OR=1.60, 95% CI, 1.24-2.00, $p<.001$), among the physician mothers.

Further two studies investigate slightly different independent variables. One coming to the result, that availability of break times is significantly associated, instead of the flexibility of those breaks in a study of a sample of lower socioeconomic status: Lauer et al. (2019) describes that compared to women enrolled in the WIC program who breastfed less than four months, a greater percentage of women who breastfed for four months or longer had pumping break times that were provided (53.3% vs. 39.8%, $p=.032$). Certainly, for the provision of flexibility of those break times, no significant differences were found by the duration of breastfeeding ($p=.077$). The other related to a sample of women working full-time and partly doing shift work being classified as lower to average socioeconomic status, showing that only making use of breastfeeding breaks is significantly associated instead of just being aware of those break times being available: Tsai (2013) detected, that the odds of making use of breastfeeding breaks was 33.1 (95% CI: 18.0–64.1, $p<.0001$) times higher among women who continued breastfeeding for the first six months after returning to work, and 51.6 (95% CI: 31.2–121.6, $p<.0001$) times higher among women who continued breastfeeding for more than six months after returning to work, compared to women categorized as not having continued breastfeeding after return to work. However, there was no significant relationship between being aware of breastfeeding breaks and continued breastfeeding for up to six months ($p=.750$) and more than six months ($p=.692$) after returning to work.

As mentioned above, the study of Kozhimannil et al. (2016) shows contradicting results within the study based on the different analysis methods used: the results show an increased odds of breastfeeding exclusively if sufficient break time is available for women, they also detect, that these women are 3.00 times as likely to breastfeed at all (95% CI: 1.23–7.32, $p<.05$) at six months postpartum compared with women without access to break time. However, the hazard ratio of continuation of any breastfeeding (just like for exclusive breastfeeding) doesn't show a significant relationship with having reasonable break time for breastfeeding (Kozhimannil et al., 2016).

Conversely, two studies did not find any significant correlation. As with exclusive breastfeeding, within the study of Spitzmueller et al. (2016), also using some sort of survival

analysis, availability of break time was found uncorrelated with the hazard rate for continued breastfeeding during the first 12 months of an infant's life ($B=0.19$, $Wald=1.47$, $p=.23$). Just as the study by Bono and Pronzato (2022), investigating women of average socioeconomic status, didn't find significant correlations between the availability of extended breaks and breastfeeding status at four or six months postpartum ($p>.05$).

Even if study results are not consistently significant, a vast amount of studies (comprising 3,712 participants in summary) find significant associations with some sort of outcome related to any breastfeeding duration, in part even with a high effect size. The evidence seems to be better for the endpoint of any breastfeeding than for exclusive breastfeeding.

When both endpoints are considered together, in total four out of ten studies show no significant associations at all, of which two focus on exclusive breastfeeding. Nonetheless, six studies, comprising 3,712 participants in total, found significant associations between different independent variables related to break time at the workplace and improved breastfeeding outcomes. Among those are three focusing on the general availability of break times or having a schedule accommodating for breastfeeding breaks, two detecting the availability of sufficient break time, and one relating to making use of breastfeeding breaks. Due to the overall amount and weight of evidence, it can most likely be assumed that features related to break time might be somehow associated with any breastfeeding. The level of certainty of evidence is however consistently very low.

4.5.2 Breastfeeding Space

Second most frequently, available breastfeeding space that is not public and that is not a toilet or closet is studied unilaterally ($n=7$).

Study	Outcome variable	Independent variable		DoA	CoE
		Significant	Not significant		
1.	Duration of exclusive breastfeeding		Appropriate place at work for breastfeeding	(+)	Very low
2.	Exclusive breastfeeding at six months		Reasonable private space	(+)	Very low
	Continuation of exclusive breastfeeding	Reasonable private space			
3.	Duration of exclusive breastfeeding during the first 6 months of the infant's life		Availability of convenient space suitable for breastfeeding	(+)	Very low
			Availability of refrigerator		

Note:

1. Alvarez et al., (2015), USA
2. Kozhimannil et al. (2016), USA
3. Spitzmueller et al. (2016), USA

DoA=Direction of association, illustrated by (+) for a positive and (-) for a negative association;
CoE= Level of certainty of the evidence for each outcome, ranging from very low, to low, moderate or high.

Table 8: Studies investigating the association of space on outcomes related to exclusive breastfeeding, own table

Again, the impact on **exclusive breastfeeding** is studied less often ($n=3$), with one study showing a significant association (Kozhimannil et al., 2016), as depicted in Table 8. However, the study comprises contradicting results again (see chapter 4.5.1), as now the survival analysis shows a significant result, in contrast to the multivariate logistic regression. In more detail, the study of Kozhimannil et al. (2016) investigated 550 employed women in the USA, among which the result of the survival analysis showed that workplace accommodations are significant predictors of breastfeeding duration, as women with private space were 3.81 times as likely, respectively, to continue breastfeeding exclusively each month (95% CI: 1.41-10.34, $p<.01$). However, no significant relationship is detected between women with reasonable private space for breastfeeding and the likelihood of breastfeeding exclusively at six months (statistical measures are not reported). Also, according to Alvarez et al., (2015) there was no significant relationship between appropriate place for breastfeeding and the duration of exclusive breastfeeding among 29 female lawyers working at a university. Similarly, in the study of Spitzmueller et al. (2016) availability of convenient space suitable for breastfeeding was found uncorrelated with the hazard rate for exclusive breastfeeding during the first six months postpartum ($B=-0.45$, Wald=2.59, $p=.11$). Therefore, amount and weight of evidence is low in terms of an association of reasonable space and exclusive breastfeeding. Furthermore, certainty of evidence is consistently very low among outcomes assessed.

Study	Outcome variable	Independent variable		DoA	CoE
		Significant	Not significant		
1.	Duration of any breastfeeding	Appropriate place at work for breastfeeding		(+)	Very low
2.	Any breastfeeding at four months postpartum	Availability of facilities to express milk		(+)	Very low
			Availability of facilities to breastfeed		
		Availability of any breastfeeding facility at work			
	Any breastfeeding at six months postpartum	Availability of facilities to express milk			
		Availability of facilities to breastfeed			
		Availability of any breastfeeding facility at work			
3.	Any breastfeeding at six months		Reasonable private space	(+)	Very low
	Continuation of any breastfeeding				
4.	Any breastfeeding four months or longer	Having a private pumping space		(+)	Very low
5.	Pumping to personal goal	Having a dedicated private space		(+)	Very low
	Any breastfeeding for 12 months or longer		Having a dedicated private space		

6.	Duration of continuation of any breastfeeding during the first 12 months of the infant's life		Availability of convenient space suitable for breastfeeding	(+)	Very low
7.	Continuation of any breastfeeding during the first six months after returning to work		Having access to an independent breastfeeding space	(+)	Very low
	Continuation of any breastfeeding for more than 6 months after returning to work	Having access to an independent breastfeeding space			
<p>Note:</p> <ol style="list-style-type: none"> 1. Alvarez et al., (2015), USA 2. Bono and Pronzato (2022), UK 3. Kozhimannil et al. (2016), USA 4. Lauer et al. (2019), USA 5. Melnitchouk et al. (2018), USA 6. Spitzmueller et al. (2016), USA 7. Tsai (2013), China <p>DoA=Direction of association, illustrated by (+) for a positive and (-) for a negative association; CoE= Level of certainty of the evidence for each outcome, ranging from very low, to low, moderate or high.</p>					

Table 9: Studies investigating the association of space on outcomes related to any breastfeeding, own table

Tsai (2013) detected, that the odds of having access to an independent breastfeeding space was 2.38 (95% CI: 1.14–6.32, $p=.0284$) times higher among women who continued breastfeeding for more than six months after returning to work compared to women categorized as not having continued breastfeeding after return to work. There was no significant relationship between having access to independent breastfeeding space and continued breastfeeding for up to six months after return to work, $p=.705$. Also, within the study of Melnitchouk et al. (2018) including a sample of physicians (N=1,606) working in different practices in the USA, the reported results are differing: while in adjusted analysis an association between having a dedicated private space and any breastfeeding for twelve months or longer is not found ($p=.42$), a significant association with pumping to personal goal was found (OR=1.44, 95% CI: 1.14-1.81, $p=.002$).

Only two studies, that (in part) have already shown no significant associations for the endpoint of exclusive breastfeeding, also do not show significant association between availability of reasonable breastfeeding space and any breastfeeding measured in different ways; including the study of Kozhimannil et al. (2016) who detected no significant relationship between women with reasonable private space for breastfeeding and likelihood of any breastfeeding at six months. The hazard ratio of duration of any breastfeeding was also not significant. Additionally, Spitzmueller et al. (2016), state that availability of convenient space suitable for breastfeeding was found uncorrelated with the hazard rate for continued breastfeeding during the first 12 months of infant's life ($B=-0.19$, Wald=0.97, $p=.33$).

Although not all studies consistently show significant results, five out of seven studies, comprising in summary 6,126 participants, provide some evidence that the availability of breastfeeding space might have an impact on any breastfeeding or breastfeeding to personal

goal. In total for both endpoints, only one study (Spitzmueller et al., 2016) found no significant association at all on any breastfeeding indicator that was investigated. Hence, six studies, comprising 6,676 participants, found significant associations. Among those, mostly the impact of availability of appropriate private space for breastfeeding is studied. So, due to the amount and weight of the evidence it can be assumed that, that providing suitable breastfeeding space could have a positive impact on breastfeeding duration. However, the certainty of evidence is rated as very low.

4.5.3 Single Utility Items

Closely related to the previous chapter seems to be the impact that single utility items might have on breastfeeding behavior. In total, two of the studies that investigated breastfeeding space as an independent variable, also concentrate on single **utility items** provided.

Study	Outcome variable	Independent variable		DoA	CoE
		Significant	Not significant		
1.	Any breastfeeding four months or longer		Availability of chair and/ or space with locked door	(+)	Very low
			Utilities: electrical outlet, nearby sink		
2.	Duration of continuation of any breastfeeding during the first 12 months of the infant's life		Availability of refrigerator	(+)	Very low
	Duration of exclusive breastfeeding during the first 6 months of the infant's life				
Note: 1. Lauer et al. (2019), USA 2. Spitzmueller et al. (2016), USA DoA=Direction of association, illustrated by (+) for a positive and (-) for a negative association; CoE= Level of certainty of the evidence for each outcome, ranging from very low, to low, moderate or high.					

Table 10: Studies investigating the association of single utility items on outcomes related to exclusive and any breastfeeding, own table

As it can be seen in Table 10, none of the variables are significantly associated. Neither for providing a refrigerator, nor for a simple chair and/or a space with a locked door, nor utilities such as an electrical outlet or nearby sink. The relationship of the availability of a refrigerator with exclusive breastfeeding during the first six months postpartum was investigated by Spitzmueller et al. (2016) with $B=0.69$, $Wald=2.60$, $p=.11$. Within the same study, the availability of refrigeration options for expressed milk was found to be uncorrelated with the hazard rate for continued breastfeeding in the sample of 859 women who returned to work ($B=-0.14$, $Wald=0.20$, $p=.66$). Lauer et al. (2019) describes that for women having stated that onsite items such as a chair and/ or space with a locked door were provided, no significant differences were found by the duration of breastfeeding ($p=.200$). The same applies to technical support items including electrical outlet and/ or a nearby sink. Even if it is stated that compared to women who breastfed less than four months, a greater percentage of women who breastfed four months or longer had utilities that supported breastfeeding (85.9% versus 69.5%, $p=.022$), this result was not significant after Bonferroni correction (Lauer et al.,

2019). In addition to the fact, that no associations were detected, since these are isolated studies that examine different individual aspects, they have little evidential value. Also, the certainty of the evidence is rated very low for the outcomes investigated. Therefore, it is difficult to make a statement at all about the impact of the availability of single utilities that shall support breastfeeding.

4.5.4 Supervisor and Coworker support

The third most frequently studied approach is support for breastfeeding on the part of the workplace, more specifically from supervisors and colleagues (n=6). Again, fewer studies investigate the impact on exclusive breastfeeding (n=3) compared to any breastfeeding (n=5).

Study	Outcome variable	Independent variable		DoA	CoE
		Significant	Not significant		
1.	Duration of exclusive breastfeeding	Supportive colleagues		(+)	Very low
2.	Exclusive breastfeeding at six months of infant's age		Perceiving that managers and work colleagues think more poorly of workers expressing milk or breastfeeding at work	(-)	Very low
3.	Duration of exclusive breastfeeding during the first 6 months of the infant's life		Coworker negative comments	(-)	Very low
		Supervisor negative comments			
		Perceptions of workplace support for breastfeeding		(+)	

Note:
 1. Alvarez et al. (2015), USA
 2. Smith et al. (2013), Australia
 3. Spitzmueller et al. (2016), USA
 DoA=Direction of association, illustrated by (+) for a positive and (-) for a negative association;
 CoE= Level of certainty of the evidence for each outcome, ranging from very low, to low, moderate or high.

Table 11: Studies investigating the association of supervisor and coworker support on outcomes related to exclusive breastfeeding, own table

With regard to **exclusive breastfeeding**, it can be seen from Table 11, that two out of three studies show significant results. An addition to these findings can be seen in the study result of Bai and Wunderlich (2013), already mentioned in chapter 4.5.1. In combination with other independent variables, they found coworker support to make use of breaks for breastfeeding not being significantly correlated with exclusive breastfeeding duration.

The study of Alvarez et al. (2015), including only a small sample of lawyers (N=29) working at a university, shows that Spearman's rank correlation was positive and significant, with a medium to large effect size, for the relationship between collegial support and duration of exclusive breastfeeding ($r(27)=.402, p=.031$). The analysis conducted in the study by Spitzmueller et al. (2016) among 859 women who returned to work, depicted on the one hand that supervisors' negative comments regarding breastfeeding were related to the hazard rate of exclusive breastfeeding during the first six months postpartum ($B=2.09, Wald=9.86, p=.002$), meaning that one-unit higher ratings on supervisor negative comments

toward breastfeeding was associated with a 8.10 times higher likelihood of stopping exclusive breastfeeding during the first six months of the infant's life. On the other hand, coworkers' negative comments were unrelated ($B=-0.84$, $Wald=3.21$, $p=.07$). However, women's general perceptions of workplace support for breastfeeding after they return to work were again related to the hazard rate of duration of exclusive breastfeeding during the first six months postpartum ($B=-0.35$, $Wald=6.59$, $p=.01$), indicating that working mothers who reported one unit of higher workplace support for breastfeeding were 0.70 times less likely to stop exclusive breastfeeding within this time period. So, the variable "negative comments of colleagues" is found being unrelated with duration of exclusive breastfeeding during the first six months postpartum. At the same time, the perception of support by the workplace in general and "supervisor negative comments" are found to be related (Spitzmueller et al., 2016).

Another study of Smith et al. (2013), discovering 304 employee mothers of different workplaces in Australia, does also not find a significant relationship between whether managers and work colleagues were perceived to think more poorly of workers expressing milk or breastfeeding at work and exclusive breastfeeding at six months of infant's age, $p=.075$.

Since the assumption that some form of supportiveness or lack of unsupportiveness promotes breastfeeding practices is basically only supported by one study for each case (on the part of colleagues, supervisors or the workplace in general), amount and weight of the evidence is estimated low for the outcome of exclusive breastfeeding, if these variables are considered separately. If they are considered in sum, two out of three studies, including 888 participants in total, find some significant associations. Level of certainty is rated very low.

Except for the study of Smith et al. (2013), all other studies of this subgroup ($n=5$) investigate the end point of **any breastfeeding** (see Table 12). Out of these, all studies despite those from Lauer et al. (2019) and Spitzmueller et al. (2016) show significant associations ($n=3$). All three investigate the independent variable of collegial support, including the encouragement to take breastfeeding breaks or perceived (lack of) support, and two of them investigate supervisor support.

Study	Outcome variable	Independent variable		DoA	CoE
		Significant	Not significant		
1.	Duration of any breastfeeding	Supportive colleagues		(+)	Very low
2.	Any breastfeeding four months or longer		Supportive colleagues	(+)	Very low
			Supportive supervisor		
3.	Any breastfeeding duration	Supportive colleagues		(+)	Very low
		Supportive supervisor			
		Perceived lack of support for breastfeeding at work		(-)	

4 Results

4.	Duration of continuation of any breastfeeding during the first 12 months of the infant's life		Coworker negative comments	(-)	Very low
			Supervisor negative comments		
			Perceptions of workplace support for breastfeeding	(+)	
5.	Continuation of any breastfeeding during the first six months after returning to work	Receiving encouragement by colleagues to take breast pumping breaks		(+)	Very low
		Receiving encouragement by supervisors to take breast pumping breaks			
	Continuation of any breastfeeding for more than 6 months after returning to work	Receiving encouragement by colleagues to take breast pumping breaks			
		Receiving encouragement by supervisors to take breast pumping breaks			
<p>Note:</p> <ol style="list-style-type: none"> 1. Alvarez et al. (2015), USA 2. Lauer et al. (2019), USA 3. Sattari et al. (2013), USA 4. Spitzmueller et al. (2016), USA 5. Tsai (2013), China <p>DoA=Direction of association, illustrated by (+) for a positive and (-) for a negative association; CoE= Level of certainty of the evidence for each outcome, ranging from very low, to low, moderate or high.</p>					

Table 12: Studies investigating the association of supervisor and coworker support on outcomes related to any breastfeeding, own table

In more detail, in Alvarez et al., (2015), the Spearman's rank correlation was positive and significant, with a medium effect size, for the relationship between collegial support and duration of any breastfeeding ($r(27)=.448$, $p=.032$) among the 29 female lawyers working at a university. Tsai (2013) conducted a study in China, including 715 female employees doing jobs in cleaning rooms and offices within an electronics manufacturing company, including full-time working women who also do shift-work in part. It was detected, that the odds of receiving encouragement by colleagues to take breast pumping breaks was 2.53 (95% CI: 2.21–5.32, $p=.0133$) times higher among women who continued breastfeeding during the first six months after returning to work compared to women categorized as not having continued breastfeeding after return to work¹⁵. The odds of receiving encouragement by supervisors was 2.45 (95% CI: 1.17–5.05, $p=.0156$) times higher. Whereas among women continuing breastfeeding for more than 6 months after returning to work, the odds of receiving encouragement by colleagues to take breast pumping breaks was 2.78 (95% CI: 1.14–6.76, $p=.0235$) times higher, compared to women who didn't continue. Here the odds of receiving encouragement by supervisors was 2.44 (95% CI: 1.06–5.61, $p=.0355$) times higher. Therefore, collegial and supervisor support are described as significant predictors of continued breastfeeding within the study (Tsai, 2013). Another study conducted in the USA investigated 130 female physicians working at academic institutions (Sattari et

¹⁵ Definition of the reference group: working mothers who did not breastfeed at the beginning of maternity leave or breastfed for less than 1 month after returning to work

al., 2013). It was found that the breastfeeding duration increased by 1.3 months, 95% CI: 0.366-2.25 ($r=.19$, $p=.011$), for each one unit increase in perceived level of enhanced collegial support (always supportive compared with usually supportive). Also, an increase by 1.1 months, 95% CI: 0.263-1.90 (no r reported, $p=.010$), of breastfeeding duration was detected for each one unit increase in perceived level of enhanced support by the program director or chief (always supportive compared with usually supportive). Furthermore, those that perceived lack of support for breastfeeding at work, due to perceived special favors by colleagues, had 3.5 months, 95% CI: -6.77 - -0.145 (no r reported, $p=.037$), decrease in duration (Sattari et al., 2013).

The study of Lauer et al. (2019), however, shows results that are in contrast to those mentioned so far. In women from the WIC program it is investigated if there is a difference in the number of women stating whether coworkers or supervisors are supportive or not when comparing the group of women breastfeeding four months or longer with the group of women who breastfeed less than four months. In comparison, no significant differences were found by duration of breastfeeding (56.2% vs. 46.6%, $p=.289$ and 58.7% vs. 46.1%, $p=.155$). Although Spitzmueller et al. (2016) reports mostly significant results for the outcome of exclusive breastfeeding during the first six months postpartum, this is not the case for the endpoint of any breastfeeding during the first twelve months postpartum. Analysis conducted among 859 women who returned to work, did not support negative relationships between supervisor or coworker negative comments regarding breastfeeding and working women's breastfeeding continuation (Supervisor negative comments: $B=0.24$, Wald=0.20, $p=.65$; Coworker negative comments: $B=-0.28$, Wald=0.67, $p=.41$). Also, women's general perceptions of workplace support for breastfeeding after they return to work were unrelated to breastfeeding continuation during the first 12 months postpartum ($B=-0.11$, Wald=1.24, $p=.27$).

It is apparent, that results are not showing significant associations consistently. However, three studies, comprising 874 participants in summary, find an association of some sort of collegial support on any breastfeeding outcomes, and two studies, comprising 845 participants, find an impact of some sort of supervisor support; being it general perceived support or more specific in form of encouragement to take breastfeeding breaks. In total for all endpoints discovered, three studies (N=874) show significant results in terms of collegial support, and also three studies (N=1,704) show significant results for supervisor support. Additionally, two studies (N=989) show a significant association regarding general workplace support. Altogether, four studies (N=1,733) show significant associations of any provided support on any breastfeeding outcome. Therefore, it can be suggested that support by colleagues and supervisors or the workplace as its whole might have a positive impact on

breastfeeding outcomes. However, the overall certainty of evidence is very low among all outcomes.

4.5.5 Workplace Policy

There are three studies included in this review that solely investigate the independent variable of provision or awareness of a policy supporting breastfeeding at the workplace.

Study	Outcome variable	Independent variable		DoA	CoE
		Significant	Not significant		
1.	Exclusive breastfeeding duration		Availability of a written workplace policy regarding breastfeeding	(+)	Very low
2.	Any breastfeeding four months or longer		Availability of a written policy on breastfeeding or pumping	(+)	Very low
3.	Exclusive breastfeeding at six months of infant's age	Being aware of a workplace policy supporting mothers expressing milk or breastfeeding		(+)	Very low
Note: 1. Bai and Wunderlich (2013), USA 2. Lauer et al. (2019), USA 3. Smith et al. (2013), Australia DoA=Direction of association, illustrated by (+) for a positive and (-) for a negative association; CoE= Level of certainty of the evidence for each outcome, ranging from very low, to low, moderate or high.					

Table 13: Studies investigating the association of a workplace policy on outcomes related to exclusive and any breastfeeding, own table

It can be seen from Table 13, that two of these studies investigate an endpoint related to **exclusive breastfeeding**. One study investigates the availability of and the other investigates awareness of a workplace policy. The first aspect is investigated by Bai and Wunderlich (2013) who detect no significant correlation between the availability of a written workplace policy regarding breastfeeding and the duration of exclusive breastfeeding, $p=.24$. The second mentioned aspect is outlined by Smith et al. (2013) stating that in a sample of 304 employee mothers, being aware of a workplace policy supporting mothers expressing milk or breastfeeding was significantly associated with higher rates of exclusive breastfeeding, as in workplaces where mothers knew there was a breastfeeding policy, 61% exclusively breastfed at six months and in workplaces where the employees were unsure or knew there was no such policy, 34% had exclusively breastfed ($p=.016$). In contrast to the results of these two studies, which are based on a study sample of rather average to higher socioeconomic status, the results of the study by Lauer et al. (2019) didn't find a significant difference in the duration of **any breastfeeding** in women from the WIC program depending on whether they stated, that their workplace has a written policy on breastfeeding or pumping or not, $p=.240$. Finally, given the small quantity and the low weight of the available evidence, it is difficult to make a supportable presumption of a connection between the measure of a written policy at the workplace and the improvement of breastfeeding practices. The level of certainty of evidence is rated as very low.

4.5.6 Combined Measures

There are five studies that examine multiple measures in combination. Of these, two have an endpoint related to exclusive breastfeeding and four (also) relate to any breastfeeding. Among the investigated measures are combined variables, most of which have already been mentioned individually in the previous chapters. However, also a specially designed program for breastfeeding promotion is included, as well as breastfeeding education, information, and consultation; but also, rental breast pumps or on-site daycare are among the independent variables.

Study	Outcome variable	Independent variable		DoA	CoE
		Significant	Not significant		
1.	Exclusive breastfeeding duration	Workplace environment: <ul style="list-style-type: none"> Commonness of breastfeeding in the workplace Supervisor/peer support, and A quiet space other than a bathroom for pumping when needed. 		(+)	Very low
		Refrigerator, rental breast pumps and on-site day care			
2.	Exclusive breastfeeding at six months	<ul style="list-style-type: none"> Reasonable break time, and Private space. 		(+)	Very low
	Continuation of exclusive breastfeeding				
Note: 1. Bai and Wunderlich (2013), USA 2. Kozhimannil et al. (2016), USA DoA=Direction of association, illustrated by (+) for a positive and (-) for a negative association; CoE= Level of certainty of the evidence for each outcome, ranging from very low, to low, moderate or high.					

Table 14: Studies investigating the association of combined measures on outcomes related to exclusive and exclusive breastfeeding, own table

Table 14 illustrates the two studies referring to **exclusive breastfeeding** were conducted in the USA. The samples are of average and higher socioeconomic status and they both found a significant association (Bai & Wunderlich, 2013; Kozhimannil et al., 2016). Bai and Wunderlich (2013) studied the relationship between the workplace environment, including the commonness of breastfeeding in the workplace, supervisor/peer support, a quiet space other than a bathroom for pumping when needed, and the duration of exclusive breastfeeding. The impact of the different sub-indicators was not detected individually but in summary for the dimension “workplace environment”. Spearman’s rank correlation was positive between the two variables, showing a small effect size ($r(111)=.26$, $p=.01$). Additionally, they studied the relationship between technical support, including the availability of a refrigerator for storing breast milk, of rental breast pumps and of on-site day care at the workplace, and the duration of exclusive breastfeeding by the 113 working mothers in different worksites. Spearman’s rank correlation was computed to assess the relationship. The correlation was positive, and of large effect size, between the two variables, $r(111)=.71$, $p=.01$ (Bai & Wunderlich, 2013). The other study by Kozhimannil et al. (2016) provides data on the impact

on reasonable break time and private space individually (see previous chapters 4.5.1 and 4.5.2), but also reports the association with breastfeeding practices when both accommodations are available. With the result that women with access to both were 2.56 times as likely to breastfeed exclusively at six months (95% CI: 1.03-4.95, $p < .05$). Also, survival analysis showed, that women with both accommodations were 1.45 times as likely to continue breastfeeding exclusively each month (95% CI: 1.08-2.06, $p < .05$). As for both analysis methods used in the study, the results are significantly related, these attributes additional weight of evidence to the results of this study.

Examined associations are consistently significant. Both studies together comprise 663 participants. However, both studies investigate very heterogeneous combinations of breastfeeding promotion interventions. The amount and weight of evidence is therefore estimated to be low. Also, the certainty level of evidence is rated very low among the outcomes.

Study	Outcome variable	Independent variable		DoA	CoE
		Significant	Not significant		
1.	General continuation of any breastfeeding after returning to work	<ul style="list-style-type: none"> ▪ Availability of four designated breastfeeding areas, and ▪ Provision of breastfeeding education (including matters like benefits of breastfeeding, pumping, preserving or storing breast milk). 		(+)	Low
	Continuation of any breastfeeding within the first six months postpartum				
	Any breastfeeding for six to twelve months				
	Any breastfeeding for one to two years				
	Any breastfeeding for longer than two years				
2..	Duration of any breastfeeding	WBSS score, including: <ul style="list-style-type: none"> ▪ Technical support, ▪ Supervisor or coworker support, ▪ Available breastfeeding space, or ▪ Break time. 		(+)	Very low
3.	Any breastfeeding at six months		<ul style="list-style-type: none"> ▪ Reasonable break time and ▪ Private space 	(+)	Very low
	Continuation of any breastfeeding				
4.	Any breastfeeding continuation rate at three months after returning to work	Program: <ul style="list-style-type: none"> ▪ 90 min breastfeeding class, ▪ Use of a pamphlet, ▪ Distribution of a newsletter upon return to work, and ▪ Email consultation up to three months after returning to work. 		(+)	Low
Note: 1. Cervera-Gasch et al. (2021), Spain 2. Huang et al. (2023), China 3. Kozhimannil et al. (2016), USA 4. Nakada (2021), Japan DoA=Direction of association, illustrated by (+) for a positive and (-) for a negative association; CoE= Level of certainty of the evidence for each outcome, ranging from very low, to low, moderate or high; WBSS=Workplace breastfeeding support scale					

Table 15: Studies investigating the association of combined measures on outcomes related to exclusive and any breastfeeding, own table

Despite above-mentioned significant results with regard to exclusive breastfeeding, the study by Kozhimannil et al. (2016) is the only one out of the four studies to show no significant results for the outcome of **any breastfeeding** at six months and for the hazard ratio of duration of any breastfeeding. As can be seen in Table 15, the other three conducted in China, Spain, and Japan, however, do. The study of Huang et al. (2022) including a sample of average socioeconomic status, full-time working women of rather lower average age compared to the other studies, summarizes nearly all mentioned approaches (except for workplace policy) in one variable using the workplace breastfeeding support scale (WBSS). So, they don't provide an individual result for the dimensions of technical support, supervisor or coworker support, available breastfeeding space, or break time, but summarize the scores of these dimensions, which are again measured by different items. In the end, the final WBSS score is reported, measuring mothers' general perception of support for breastfeeding in the workplace. It is not possible to draw conclusions about the results of the individual dimensions in the study. Within the survey of 1,243 women, multiple linear regression was used to test among other things if a high WBSS score predicted the duration of any breastfeeding. The overall regression was statistically significant, $F=16.872$, $p<.001$, indicating that the factors under study have significant impact on any breastfeeding duration. Moreover, the adjusted $R^2=.178$ depicts that the model explains 17.8% of the variance in any breastfeeding duration. Additionally, among other things the coefficient of WBSS score was further assessed to ascertain the influence on the outcome variable. The results revealed that a high WBSS score is significantly and positively associated with duration of any breastfeeding, $B=.04$, $\beta = 0.133$, $p<.001$ (C. Huang et al., 2022).

Also the results of Cervera-Gasch et al. (2021), who conducted one of the two studies within this review using a different other than cross-sectional study design, are significant. They investigated 301 female teachers, researchers, administration, or service staff at two different universities. One is the case institution, which has four designated breastfeeding areas and offers breastfeeding education, including matters like the benefits of breastfeeding, pumping, preserving, or storing breast milk. The other one is the control institution with no breastfeeding room and no breastfeeding support program. It is detected, that generally 71.8% of women from the case institution continued breastfeeding generally after returning to work, compared to 50.5% in the control institution ($p=.001$). A lot more women from the control institution (39.9%) discontinued breastfeeding within the first six months postpartum compared to the case institution (15.5%). The results are significant ($p<.0001$). The difference in the breastfeeding duration of six to twelve months is not very high, but slightly more women in the control group discontinue in this time span (13.6% in the case group and 18.2% in the control group), while again more women in the case group breastfed for one to two years (28.2%) or even longer than two years (32.0%) compared to the control group,

where 16.7% breastfed for one to two years and 10.6% breastfed for longer than two years. 4% of women were still breastfeeding in the control group, when the data was collected. All these results are significant ($p=.001$).

The study of Nakada (2021) represents the other study with a different other than cross-sectional study design. It was conducted in Japan among 141 smoking participants classified as of average to higher socioeconomic status and comprises a whole breastfeeding program, including different measures. The program group received different interventions before returning to work, including a 90 min breastfeeding class, the use of a pamphlet, distribution of a newsletter upon return to work and an Email consultation up to three months after returning to work. Another group only received the pamphlet before returning to work and the comparison group didn't get any intervention. It was found, that the breastfeeding continuation rate at three months after returning to work was significantly higher in the program group than in the comparison group (79.2% vs. 51.1%, $p=.004$), but there was no significant difference between the pamphlet and comparison group ($p=.07$). After adjusting for background factors, the program intervention was associated with increased odds of breastfeeding at three months after return to work (adjusted odds ratio=4.68, 95% CI: 1.57-13.96, $p=.006$).

Finally, independent variables measured differ a lot in terms of their composition of measures. However, there is one aspect all have in common, namely that they investigate a set of different measures applied in combination. One study does not show significant associations between a two-component set of interventions with outcomes related to any breastfeeding. So, in total, three studies, comprising in total 1,685 participants, support the assumption that applying a combination of measures is associated with prolonged any breastfeeding duration. Overall, all studies, comprising in summary 2,235 participants, investigate at least one significant outcome for one of the dependent variables related to breastfeeding duration. Even though independent variables are heterogenous, in terms of significant association with the outcome of breastfeeding duration, results are in some way showing to be consistent in this subgroup. This is also noticeable in comparison to the other subgroups, and seems to put more evidential weight on this section. So, for this subgroup it is judged that, in terms of weight and amount, there is some evidence. Also, the level of certainty is rated slightly better for this subgroup than for the previously mentioned, as the outcomes of two out of five studies are rated as low. Others are rated very low as well. So overall, evidence and certainty of this evidence is rated slightly better than for the other subgroups.

5 Discussion

5.1 Findings of the Systematic Review

The identified interventions were grouped into six categories that represent different intervention approaches, each of which includes a variety of different implementation options for promoting breastfeeding among working mothers. Identified intervention approaches include break time and space for breastfeeding, support by the workplace, supervisors, and coworkers, but also the availability of single utility items or a workplace policy is discovered, as well as a combination of measures, in which partly also further interventions focusing on consultation or education are included. If the respective study results are observed, none of these approaches is consistently significantly associated considering all different breastfeeding outcomes that are examined. However, based on the amount and weight of evidence available, it is suspected, that for some measures, one can rather make the statement that they are promising in terms of improving breastfeeding duration than for others. This differentiation becomes apparent from Figure 19.

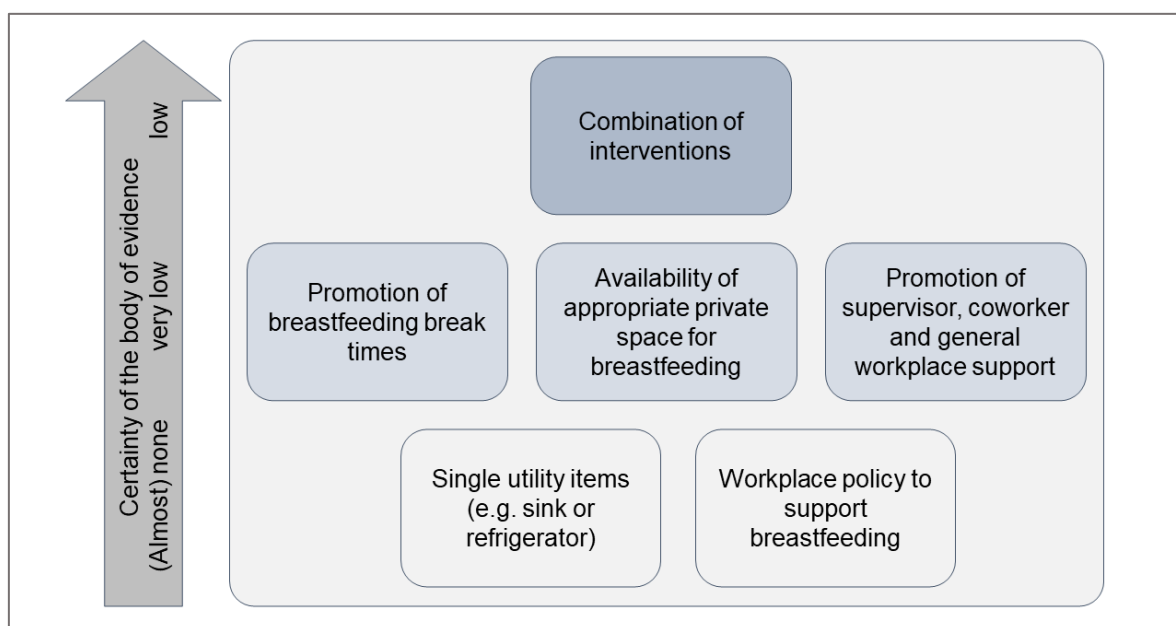


Figure 19: Level of certainty of evidence of approaches to promote breastfeeding among working mothers in high-income countries, own figure

Starting from the bottom of Figure 19, is difficult to make a profound assumption about the impact of the availability or awareness of a written workplace policy or the provision of single utility items on improved breastfeeding outcomes. It is apparent that both studies examining the availability of a **workplace policy** show no significant associations, whereas the study examining the awareness of a policy does. This could be an indication that the measure of introducing a workplace policy is only successful if sufficient awareness of its existence is created. So, it might be assumed that the mere existence of a workplace policy on

breastfeeding support is not sufficient. Instead, it is assumed that it is important that further interventions are implemented based on this or that a certain attitude towards breastfeeding is lived in the company and does not only exist on paper. At the same time, this thesis could be refuted by the fact that in the other two studies, too, only women who were aware of the existence of a workplace policy stated that their workplace had one. Furthermore, it could be assumed that the provision of a workplace policy could represent one possible, more specific intervention contributing to the approach of workplace support. As both studies investigating **single utility items** show consistently non-significant results, this could indicate, that provision of single utility items is not enough to promote breastfeeding. This supports the assumption, that the implementation of several measures in combination might be more useful. This also seems to appear reasonable from a logical perspective. For example, when pumping breast milk in an available locked room with a chair is possible, but no opportunity for proper storage of the breast milk is available, it seems not feasible to use the room for pumping, as the milk has to be preserved properly in order to fed to the child at a later time.

For approaches related to break time or space for breastfeeding, as well as to supervisor, coworker, and worksite support there is some evidence, so they could be interpreted as promising approaches. For the sake of logic, the provision of **time** seems to be the most important basic intervention component among these as, without available time, it is not possible to use other measures, such as a breastfeeding room. In contrast, if enough time is available, mothers could breastfeed even off-site and follow through even if no support is available. Building on this, further action can be taken by approaching interventions related to providing space or improving supervisor or coworker support.

The exact design of a **breastfeeding room or space** may differ within the studies and a precise description is often missing. However, the suggestion that single utility items may not be sufficient to promote breastfeeding, paired with the consideration that multiple utility items in combination may form an equipped breastfeeding room, leads to the conclusion, that it could be decisive how such a space is equipped, meaning what items are available and what overall quality the room has. However, a comparison of the results between studies investigating whether adequate breastfeeding space is available with studies investigating the simple availability of any room does not confirm this assumption, as exactly two of the three studies investigating access to adequate breastfeeding space do not show significant results (Kozhimannil et al., 2016; Spitzmueller et al., 2016).

To encourage the use of time and potentially also space for breastfeeding, the **support of supervisors and colleagues** seems important. For instance, it may require the involvement of another workforce to interrupt work for the breastfeeding break, due to work that

might occur during this time. Working schedules might be adjusted or tasks be reorganized among the workforce to make break times logistically feasible. This makes it seem particularly important that colleagues or supervisors are also willing to support breastfeeding. Otherwise, this could negatively affect interpersonal relationships and the working atmosphere in the company. The support seems of additional value for the mother in order to take advantage of the break times to be comfortable and relaxed. Support from supervisors also appears important for women to dare to take breaks at all and to communicate that they are breastfeeding.

Compared to all other subgroups, for **combined measures**, the results were most consistently significant, and the rating of certainty of the evidence was also slightly better. Based on this, it could be assumed, that there is most likely to be some evidence, that it is promising to combine different interventions. What has been described so far illustrates that there are many entanglements in the intervention approaches and that they are partially dependent on each other, forming the rationale for the arrangement of combined interventions as a higher-level evidence approach (see Figure 19). On the basis that within the studies of this category, various different measures were examined in combination, it is cautiously interpreted, that a combination of interventions seems most promising in order to promote breastfeeding in the workplace, while it does not seem to be of so much relevance which measures are chosen. However, two of the studies among this subgroup refer to measures concerning the improvement of knowledge (e.g. education, consultation, information), and also interventions like the provision of rental breast pumps and on-site daycare are investigated by studies in this category. It remains unclear, what impact these have as stand-alone measures, which could distort the conclusion, as it could also be the case that measures aimed at education, consultation, or information are particularly useful to promote breastfeeding. Another factor that could also bias the conclusion is that some of the studies in this subgroup have a different study design and were conducted in other countries (e.g. China, Spain, and Japan) that were not included in the other subgroups.

From this discussion, three main intervention approaches emerge to achieve optimal breastfeeding promotion in the workplace, while it becomes apparent, that time is the most basic requirement, on which further interventions can be added, while combining all approaches and several interventions would lead to optimal breastfeeding promotion, as should be illustrated by Figure 20.

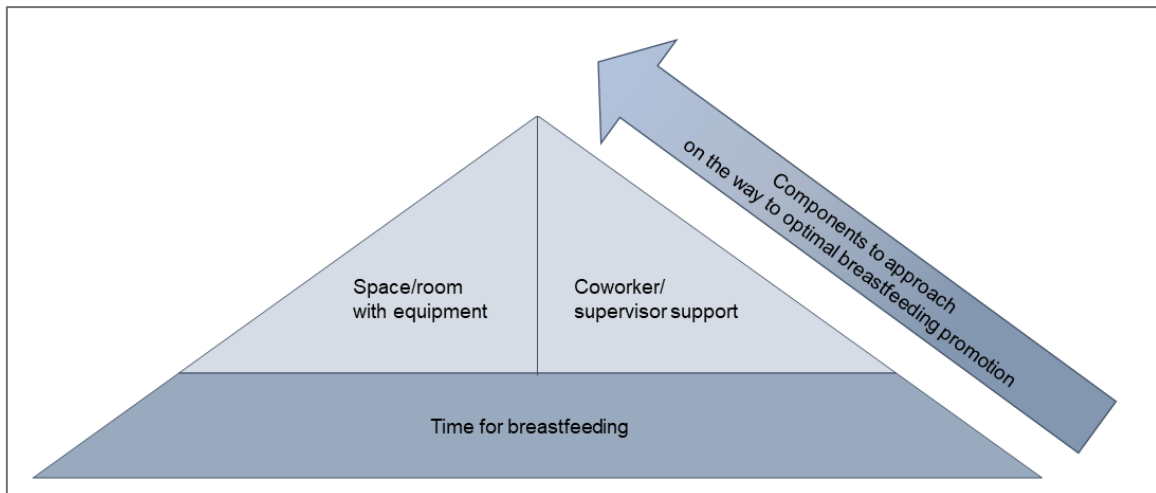


Figure 20: Components to approach in order to achieve optimal breastfeeding promotion in the workplace, own figure

It can be further observed, that often the evidence is better for associations of interventions with any breastfeeding than with exclusive breastfeeding outcomes. Particularly within the subgroups related to break time and space, this can be detected. This leads to the assumption, that it is more difficult for working mothers to continue breastfeeding exclusively even with promotional measures in place, but that the duration of any breastfeeding can be promoted.

5.2 Implications for Workplaces in Germany

Break Times

Since in Germany, there are legal regulations (see chapter 2.4.2) on the provision of breastfeeding breaks on request during the first twelve months after birth, a certain basis to fulfill the basic step of provision of time is given in theory. In addition, regulations on maternity protection and paid parental leave are in place. Due to these obligations, very few women are employed during this first period, which makes breastfeeding breaks obsolete. Nonetheless, as mothers are returning to work earlier, this protective period, which concerns approximately the infant's first year, seems to be rather shortening. Thus, the legal provisions in Germany for the period of the first year of life can generally be seen as positive for breastfeeding. However, a downward trend is suspected.

More specifically, in Germany, a minimum time is specified that employers must provide the mother for breastfeeding. It is questionable whether these time windows are sufficient to provide breast milk as needed to a child who is less than one year old as breastfeeding according to the child's needs can look very different as it is very individual (Fenner & Nieberding, 2020). For example, some children want to breastfeed regularly and at short intervals around the clock, and other children drink more during a certain period and then not for a long time (Fenner & Nieberding, 2020). At the same time, when breastfeeding on

demand, milk production is determined by the child's needs (Fallon et al., 2016, p. 2). So, prespecified breastfeeding times could hinder breastfeeding on demand. Also, some children change their breastfeeding frequency and pattern as they get older, while others do not (Fenner & Nieberding, 2020). Depending on the individual circumstances, this could indicate the appropriateness for an extension of the provision of break times beyond the child's 12th month of life, as required by law in Germany. In this context, it could also be suspected that due to the time-limited regulation, some women start breastfeeding less or weaning before the child's first birthday to not have an abrupt change. Not just for the baby to get used to, but also because breastfeeding at prescribed times can cause breast discomfort, e.g. in the form of milk engorgement for the mother (BZgA, 2021a). Thereby, it can probably be poorly adhered to the recommendation that breast milk should be the main food source of nutrition until the child is one year old. However, depending on how much complementary food the child is already receiving and how often it is still breastfed during the day, for a child being older than a year, it is usually possible to bridge the absence of the mother without breastfeeding (European Institute for Breastfeeding and Lactation, 2022a). A larger breastfeeding child therefore usually no longer needs to be brought to the mother at the legally entitled breastfeeding times, but the breastfeeding time can often be scheduled at the beginning or end of working hours (European Institute for Breastfeeding and Lactation, 2022a). However, besides the adherence to given regulations on prohibition of night work, working on Sundays, holidays, or too many hours, it might be beneficial if the mother could start later or go home earlier. So, depending on individual factors of the mother and child, the length and flexibility of the work schedule, commute time, and on-site breastfeeding opportunities, the provided break time options are deemed feasible or not. Besides these measures that go even beyond the regulations of the MuSchG in Germany, it seems important to note that when implementing the regulations of the MuSchG, it is important to ensure that protection against risks at the workplace is maintained for the entire duration of breastfeeding. Whereby the physiological breastfeeding duration and WHO nutritional recommendations (to breastfeed a child up to the age of two or beyond) should be kept in mind. With reference to breastfeeding support at the workplace after the first year of the child's life, it could even be expected that the benefit of promoting breastfeeding beyond the legal requirements could be particularly large. The reason is that it can be expected that there will be fewer restrictions due to breastfeeding as the child is less and less dependent on the regular supply of breastmilk and is able to eat other foods in the absence of the mother (European Institute for Breastfeeding and Lactation, 2022a). While the restrictions for the workplace will become smaller, the benefits of breastfeeding will continue to exist. Due to the few mothers working in the infant stage of their child and the low prevalence of breastfeeding, especially with the rising age of the child, the mandatory provision of break

times will be used rather rarely in Germany. This leads to the conclusion, that many women may not even be aware of their right to breaks for breastfeeding, as it is not very common. To this end and beyond, Rosin (2018, p. 21) describes in the context of the legalities, that despite the existence of the described entitlement to time off for breastfeeding, it is not granted automatically, but only "upon request". In practice, this means that many mothers do not take advantage of the time off because they are either unaware of their right to time off and/or do not dare to make use of this right (Rosin, 2018, p. 21). That women feel stigmatized and might therefore not dare to make use of their right to breastfeeding breaks seems to be confirmed in view of the background described (see chapter 2.3.3), and will be dealt with in more depth later, with regard to supervisor/collegial support. Based on what has been described, the following intervention opportunities to promote breastfeeding duration among employees arise for employers, of which some were also investigated by studies included in the systematic review. The employer:

- might automatically grant time off for breastfeeding to which the employee is entitled.
- may offer breaks for breastfeeding beyond the 12th month of the child, even if this is usually not needed or only needed for a limited time.
- may offer breastfeeding breaks that exceed the mandatory minimum times, with regard to duration, frequency, or flexibility, as perceived appropriate for the mother and child.
- could make sure that the working schedule facilitates breastfeeding outside of the working time (e.g. flexible hours or feasible start or finishing times).
- could (better) inform employees about their rights and potential additional provisions by the workplace.

Room with Equipment

From chapter 2.4.2 emerges, that in Germany it must be ensured that breastfeeding does not take place in unsuitable premises and thus, it may be advisable to set up suitable space for breastfeeding. However, no general obligation to provide a breastfeeding room emerges from a legal basis. Instead, if the employer does not want to provide a room or cannot do so, e.g. due to a lack of premises or if conditions cannot be provided that protect the health of the mother and the baby, the employer has an obligation during the first year of the baby's life to release the woman for a prolonged time for breastfeeding outside the company building. Breastfeeding could then for example take place at home, or if the baby is cared for in a daycare center that is close to the workplace, breastfeeding could possibly also take place there.

However, an intervention opportunity for employers in Germany that goes beyond existing legal regulations is the provision of a breastfeeding space or room. With this, it would be more feasible to either breastfeed the child on-site (e.g., a caregiver can bring the child) or

to express breast milk at the workplace. From this, the question arises, of how such a room should optimally be designed. In Germany, the ASR A4.2 provides some guidance on how to design such a room, e.g. with regard to access, privacy, materials to be used, required health protection, furnishings including seating and table, light, temperature, and air (see chapter 2.4.2). So, a first recommendation can be that employers should comply with this. However, some aspects, such as providing adequate storage facilities for breast milk, are not covered. The NSK also takes a position by describing that it is already enough if the company has a small, lockable room with a clean storage area, a comfortable seating area, a sink, and a refrigerator or cooler to fulfill a company's obligation to allow breastfeeding at the workplace (Max Rubner-Institut, 2019, p. 5). The recommendation of UNICEF (2020) on how a breastfeeding room can be optimally designed goes beyond these descriptions. As these recommendations seem much more sophisticated, the ideal basic provisions that are recommended are illustrated in the following Figure 21, which is complemented in writing, aiming at representing a potential best-practice example of a breastfeeding room.



Figure 21: Example of a basic breastfeeding room, own figure

It is described that “a breastfeeding room should be clean, comfortable, safe and a private space for women” (UNICEF, 2020, p. 14). UNICEF (2020) further outlines, that the outlet for electronic devices shall be provided for those women using an electric breast pump and should therefore be located close to the chair. The same applies to a countertop or table for holding the breast pump or other supplies. The storage system needs to be a cold one, preferably a freezer or a fridge for the exclusive use of the breastfeeding room in order to provide suitable space to preserve the breast milk until it is fed to the child. The centimeter

specification from the floor is important to ensure that it is hygienic. Additionally, it would be helpful to provide a clock, coat rack or hooks, and a full-length mirror to help check and readjust clothing before returning to work (UNICEF, 2020, p. 18). It is added that “light and ventilation are important elements in creating a warm and comfortable environment” (UNICEF, 2020, p. 19). Hygiene and the selection of cleaning agents are also of great importance in many respects (UNICEF, 2020, p. 19). Furthermore, optional facilities that should help to encourage and support mothers breastfeeding are listed by UNICEF (UNICEF, 2020, p. 20), such as a library with books, guides, brochures, or posters containing information on pregnancy, early childhood, breastfeeding and other related topics, or providing artwork, soft lighting and bulletin board, a second chair, and footrest, a breast pump, or even supplying nursing pads, breastfeeding gel packs or suitable containers into which the expressed milk can be transferred. Another addition that is mentioned is that mothers could be invited to participate in designing the breastfeeding room or to provide a comment box to allow making suggestions on modalities of improving the room (UNICEF, 2020, p. 20).

For employers who are not able to provide a breastfeeding room, but still want to support their employees beyond the provision of more break time, there are still alternative options that could be considered, which were not subject of the studies included in the systematic review. For some companies, offering home-office could be an option. Other than that, companies could also benefit from the expansion of breastfeeding friendliness at the municipal level. Networking with off-site facilities or other businesses in the immediate vicinity would be conceivable. For example, agreements could be made with public facilities that encourage breastfeeding. Solutions could be found from which both take benefit. For example, in the case of a café, the company could advertise the café, regularly purchase food from there, provide financial support, or help promote the expansion of a breastfeeding space. However, such an option seems most feasible if the child is brought to the mother to be breastfed. Pumping milk seems to be logistically more challenging, as the milk has to be preserved properly afterward. However, there might be conceivable solutions to this as well, such as a separate refrigerator at the workplace.

Furthermore, another possibility that seems to combine several aspects mentioned, could be the establishment of on-site daycare. If this is located in the direct vicinity of the company or even in the same building, breastfeeding could be carried out there, and also breastfeeding on demand could be facilitated. The direct proximity of the child can be a time advantage and it could be seen as beneficial that the child can be nursed directly at the breast, if desired, without having to travel long distances. This poses additional benefits in terms of simplicity, hygiene maintenance, and mother-child bonding. If on-site daycare is

implemented, consideration should be given to the breastfeeding-friendliness of the facility to make this work. In summary, the following intervention opportunities emerge. The employer:

- might ensure, that the woman can breastfeed under suitable conditions even if the child is already older than 12 months.
- might provide an adequately equipped room for breastfeeding, in the best case going beyond the requirements of the ASR A4.2.
- seeks the participation of concerned employees when developing a space for breastfeeding or in the process of finding the best individual strategy for where to breastfeed.
- might offer home office.
- undertakes networking with breastfeeding-friendly places in the community, and seeks agreement for the usage of suitable breastfeeding spaces provided by these.
- establishes breastfeeding-friendly on-site daycare.

Supervisor and Coworker Support

It is clear from chapter 2.3.3 that social acceptance of public breastfeeding has not only generally declined, but that the majority of the general German population (62%) do not accept breastfeeding at workplaces. This suggests, that the will to provide support for breastfeeding mothers at the workplace is low among the majority of colleagues and supervisors in Germany. In fact, the trend seems to be going in the opposite direction, with breastfeeding being stigmatized in the workplace. This could be reinforced by the deficits in the breastfeeding promotion landscape in Germany at different levels, including e.g. a lacking concrete official national recommendation that stresses the benefit of prolonged breastfeeding beyond the first year of the child's life, paired with the rather short general duration of breastfeeding in the German population. Therefore, awareness of breastfeeding and its benefits is low in the general population and could contribute to making people perceive that breastfeeding a child for a year on maximum, possibly even shorter, is the norm. This assumption is reinforced with regard to the even greater stigma of breastfeeding toddlers although this is physiologically normal and continues to have (e.g. health) advantages. Finally, this illustrates, that the state-of-the-art in Germany is assumed to be rather poor with regard to the approach or supervisor and coworker support, so the need for action in Germany seems to be high. Simultaneously, this approach seems of great importance, as other interventions involving time and space for breastfeeding would otherwise appear to make little sense if they are nonetheless not used, e.g. due to existing stigma. Due to stigma, women might even try to hide the fact that they are breastfeeding. In this case, not even the basic legal provisions (e.g. including prohibition of night work) would be provided to breastfeeding women.

In order for supervisors and colleagues to be able to honestly show supportive behavior, the general attitude toward breastfeeding is deemed important. This underpins the need for education, since in chapter 2.3.3 it is described that knowledge about the positive effects of breastfeeding is associated with increased acceptance of breastfeeding. One intervention opportunity might therefore be the target group-oriented provision of sufficient information and education. Namely, information on the benefits of breastfeeding for the child, mother, employer, and society, official recommendations, and existing statutory provisions. This is particularly important as there seems to be less knowledge in the general population compared to mothers. Two studies in this review (A. Cervera-Gasch et al., 2021; Nakada, 2021) that examine such interventions, among others, are likely to confirm that such interventions could promote breastfeeding. This intervention of increasing the knowledge on breastfeeding is seen as a major step to achieving a working environment to be supportive, as especially if there is little understanding of the importance of breastfeeding, provisions for breastfeeding working mothers could be perceived as unfair or as a burden, as e.g. the workforce has to cover the additional workload by relieving breastfeeding colleagues.

As it is not ensured in Germany that all information on infant and young child nutrition is produced free of commercial influence and conflicts of interest (Rosin, 2018), employers should carefully select those. Since the law designed to protect the public from misleading advertisements from the infant formula industry (in German called “Säuglingsnahrungswerbegesetz”) ignores key elements of the WHO Code of Marketing of Breastmilk Substitutes, advertising of infant formula is ubiquitous both locally and on the internet, and much of the information and materials used in health care on breastfeeding and infant feeding are published or influenced by the infant formula industry (Rosin, 2018, pp. 18 & 31). Additionally, none of the official national stakeholders, including the Federal Centre for Health Education (German: Bundeszentrale für gesundheitliche Aufklärung; abbreviated BZgA), the network “healthy into life” (German: Gesund ins Leben) and the NSK, support the WHO dietary recommendation on breastfeeding. In this context, it would also be an important basic step for these stakeholders to expand and concretize the national breastfeeding recommendation, placing more emphasis on prolonged breastfeeding. This could increase the acceptance of prolonged breastfeeding in society and provide a solid basis for legislators or even employers to promote breastfeeding, even beyond the first year of life. So far, employers could also justify the implementation of breastfeeding promotion measures by referring to the WHO recommendation instead of that of the NSK.

Lücke et al. (2022, p. 1194), describes, that not only communication of breastfeeding knowledge seems to be useful to promote a change in attitude toward a more understanding climate, which is desirable from the point of view of families, politics, and medicine. Instead,

measures on several levels appear to make sense. In addition to the cognitive level, this also includes the affective level, in which breastfeeding is linked with positive emotions, and the conative level, in which breastfeeding-friendly behavior is exemplified and facilitated (S. Lücke et al., 2022, p. 1194). Exemplary intervention ideas emerging from this are mentioned within the bullet points below.

Finally, if a fundamentally supportive attitude is in place, supportive behavior will possibly occur automatically. This can have many facets, representing more concrete intervention options. Supervisors could take initiative to approach the topic, which could lead to de-stigmatization. Solutions can be worked out together that take all employees into account. For example, work tasks could be rearranged, or work schedules shifted. However, it is also believed that even the provision of other promotional measures, like a well-equipped breastfeeding room or additional breastfeeding breaks beyond legal requirements provides breastfeeding mothers with perceived support from the workplace. It might directly convey appreciation and signals that breastfeeding is accepted and possibly even desired at the workplace. This would also show that breastfeeding friendliness is lived in practice in the company and does not only exist in theory. Yet, even a theoretical approach could represent a helpful start. It could be imagined, that a first step could for example be the development, dissemination, and awareness raising of a breastfeeding policy, to implement further measures on this basis in the future. Finally, the following practice examples might emerge:

- Information material appropriate to the target group could be compiled and communicated via the internal structures (e.g. regular newsletters) of the companies for the purpose of information and education.
- In large companies, a public statistic could be a possibility to show how many mothers in the company have already breastfed or how often the breastfeeding room was used. (Caution with regard to data protection and stigmatization.) In the best case, it is also calculated how strongly this on average influenced the smaller number of sick days, etc., in order to underline the advantages of breastfeeding.
- Companies could designate as breastfeeding/family-friendly, including concrete statements about what this includes in terms of breastfeeding.
- Apply measures such as group education, breastfeeding classes, individual or telephone support, and consultation.
- The employer may take the initiative and openly approaches mothers with the topic of breastfeeding and start a conversation about possible support measures. Solutions could be found considering the whole workforce.

Application in Practice

After all, it will not be possible to combine breastfeeding and work in all settings, as the protection and health of mother and child cannot be guaranteed in each context. In this case, in Germany § 13 MuSchG, para. 1 is in place, which specifies that then an employment prohibition must be imposed. Examples of occupational groups where this may occur are given in chapter 2.4.2. Therefore, the outlined opportunities can only be applied to women in workplaces in which this regulation is not applicable. Furthermore, not all interventions can be implemented uniformly at all workplaces, as the framework conditions available for implementing measures to promote breastfeeding differ. The outlined interventions for breastfeeding promotion in the workplace deliberately represent only opportunities. The practicability must be checked individually depending on the conditions at the respective workplace, and the interventions can and should be modified and adapted as needed. For example, this could relate to the distribution of information or educational offerings, which should be designed to suit the target group and carried out via suitable communication channels that fit the company in question. At the same time, different resources are available to different employers. For some work tasks, interruption of working time is easier to ensure, for others it is rather more difficult or not possible. Therefore, it is clarified at this point that the results of this thesis primarily intend to illustrate that a variety of solutions exist. The intervention options mentioned here shall serve as inspiration, with no claim to completeness, and do not ensure applicability in the individual case.

The capabilities that different companies entail might also depend on the size of the company, the sector, or the proportion of women in the company; while depending on the industry, breastfeeding protection, and breastfeeding-friendliness might have a different priority and encounter different possibilities for implementation (Dr. A.-K. Brettschneider et al., 2021, pp. 66 & 67). It could be assumed that especially larger, successful companies are more likely to have the resources for breastfeeding promotion measures. At the same time, larger companies also pay their employees better (Stepstone, 2023, p. 10). Therefore, it could be assumed, that workplace-related breastfeeding promotion is more likely to reach people who are already better off, e.g. people with higher socioeconomic status, who are already showing better breastfeeding behavior anyway. Barriers to breastfeeding exist especially for already disadvantaged target groups, including higher embarrassment toward breastfeeding in public, early return to work, breastfeeding complications, lack of self-efficacy, low income, limited social support, less education, and unsupportive childcare (chapter 2.3.3; Lauer et al., 2019). Against this background, it yet seems of particular importance that breastfeeding promotion is conducted also in small companies.

Due to described potentially limited capabilities of these, it seems important to provide external support for those companies. For example, in the form of appropriate information materials, sources of information, external contact persons, consultations, funding, or best-practice examples. Here, a need for action at various levels becomes clear. This includes the development of official information and education free of commercial influence and conflict of interest, and arrangements that ensure that workplaces do not become part of the advertisement of the infant formula industry or even possibly (unconsciously) support this. However, professional actors (e.g. midwives or physicians) who are supposed to take on an advisory role should also be better prepared, for example, by being better educated on the topic of breastfeeding promotion (Rosin, 2018, p. 25) and, by being prepared to have an advisory role, also for companies. This could also form the basis for the creation of training courses on the implementation of workplace breastfeeding promotion courses, which according to Brettschneider et al. (2021, pp. 68 & 69) could be offered to relevant stakeholders, including supervisors, human resources managers, company physicians, occupational safety specialists, staff councils, and more. However, as therefore appropriate training courses are to be developed or existing ones need to be supplemented with the topic of breastfeeding promotion, this requires not only research but also support from the official side.

Another reason that makes external support seem necessary is that it is questionable to what extent employers have an interest in promoting breastfeeding in their company, as disadvantages may be seen instead of the advantages that exist for companies. This might include a negative connotation that breastfeeding employees have more (possibly paid) break times, seem to be less flexible, or colleagues may have to pick up this work. Therefore, it seems important to educate employers about the benefits of promoting breastfeeding in their company. In general, more breastfeeding-friendly policies in other fields in Germany, including de-stigmatization and increased awareness and knowledge in society, as well as the obvious existence of external support services for employers, may encourage employers to act on the issue in the first place.

Moreover, it even seems necessary, that other deficits in the breastfeeding promotion landscape in Germany are tackled at the same time. An example is the field of child care because, during the time of work, the child must be entrusted to someone other, which is in 38% of cases done by daycare or daycare centers in Germany (Kersting et al., 2020, p. V22). However, these settings are often not equipped and trained to care for breastfed children and to feed breast milk (Rosin, 2018, p. 21). In addition, the opinion or recommendations of these professionals could influence mothers' decision to continue breastfeeding;

and there seem to be erroneous assumptions that weaning is necessary if a child goes into daycare (Brück, 2022). For example, it is assumed that settling in cannot work with a breast-fed child, or that naps would not work (Brück, 2022). This highlights a need for education and an increased need to focus on the breastfeeding-friendliness of childcare facilities.

Finally, it becomes apparent, that openness and de-stigmatization of the topic of breastfeeding and therefore a shift in the opinion of the general German population is needed, so that the topic is addressed at all. As long as breastfeeding over longer terms is stigmatized in society and awareness of the benefits of (continued) breastfeeding is largely non-existent, hardly any employer will come up with the idea of promoting breastfeeding in the workplace; and certainly not provide measures that go beyond the legal requirements. This highlights the need to approach the issue of breastfeeding promotion holistically. Against this background, the model created for the implementation of optimal breastfeeding promotion appears incomplete for Germany (see Figure 20). For any of the stages to be implemented, a change in knowledge and convictions, including normalization and de-stigmatization of the topic, appears to be a necessary prerequisite.

It is becoming clear that employers need not only external support to ensure that workplace measures are implemented but also that the workplace approach appears to be only one of many important ones. Solutions should also be found in the areas of supply and counseling structures, at the community level, in the health sector, at the level of information provision, and overall in society. In some fields, it becomes apparent that there might be a need for legislative change. The different determinants seem to be interrelated and it becomes clear, that it is not enough to advance only one aspect in Germany. In terms of prevention chains, it is considered important, that breastfeeding promotion in Germany should start at an earlier stage, and not only in the setting of work, as most children are weaned already before the mother continues her career for several reasons. Therefore, other settings and contexts should also be in the focus in the future in Germany. With this, however, the intervention level of the employer is exceeded, which is beyond the scope of this paper.

5.3 Limitations

It is apparent from the described level of evidence according to the GRADE approach as low to very low for included outcomes, that the findings resulting from this systematic review and respective interpretations should be viewed with caution. Due to the study design of included studies, no conclusions about causalities or effects are possible. Furthermore, many studies had small, homogenous samples. Many studies included mostly participants that were married or in a relationship, of estimated average to high socioeconomic status and aged around or slightly over 30, and mostly under 35. Research suggests, that women

who fit these sociodemographic characteristics show better breastfeeding behavior. Additionally, this group of women may be more motivated to participate in research studies and thus be over-represented (Hilliard, 2017, p. 43). In this regard, another limiting factor is that the included studies consistently failed to identify and account for all possible confounding factors, which may have led to erroneous assumptions. Also, this made the interpretation of results between, and in part also within the studies difficult, as inconsistent results could not be attributed to these factors due to a lack of transparency regarding sample characteristics or confounding factors. As described in chapter 4.3, different types of bias could have been an issue within studies, which compromised internal and external validity.

Furthermore, the dependent variables related to breastfeeding outcomes were defined in different ways among the identified studies. For example, the duration was surveyed at different stages of the breastfeeding period, which makes a clear interpretation of the usefulness of interventions difficult. The issue can be exemplarily described by the results of Melnitchouk et al. (2018), which showed that having a dedicated private space may in general support breastfeeding practices, as even if this intervention was not associated with the duration of any breastfeeding for twelve months, it was associated with breastfeeding to personal goal. Also, independent variables were mostly collected in different ways among studies. This makes it difficult to synthesize data and provide clear conclusive statements. Another potential source of selection bias arises from the assumption that the quality and accessibility of the accommodations may not be consistent across all employers. Furthermore, the reporting within the included studies was not always complete, so these data are missing for this systematic review. This mainly concerns non-significant values. Additionally, no studies on the topic of interest were found that were conducted in Germany. Therefore, this review is based on data from other high-income countries and contextual conditions such as the political background and thus regulations on breastfeeding in the workplace might be various, which poses difficulties in generalizability and transferability to Germany. For example, regulations on maternity leave length are different among countries, and women are not entitled to breastfeeding breaks in many countries.

Finally, the chosen methodology of the systematic review poses the limitation that the results can only be meaningful within the limits defined by the eligibility criteria. For example, there may be interventions not being identified, as qualitative studies or case studies were not included, as well as interventions studied in other than high-income countries. Another example is that only published, and English or German studies that could be accessed for full text were included in this review. This decision could have biased the result of the systematic review, as it is possible that studies with deviating results were withheld from publication (Boland et al., 2020). At the same time, there is good evidence that studies with

neutral or negative findings are less likely to be selected for publication by journal editors (Boland et al., 2020), and non-English-speaking researchers are more likely to publish their findings in non-English journals (Page et al., 2021). As not all studies available could be included, selection bias is apparent in this systematic review. Further, this review does not consider the effect of the quality of interventions, as well as the impact of maternity leave, full- or part-time work status, or commute time to work. Also, with regard to outcome variables, studies were excluded if intermediate variables were investigated, including e.g. intention to breastfeed, attitude towards breastfeeding, self-efficacy, or perceived knowledge. In addition, ongoing and unpublished data sources could have been searched, and relevant studies could have been found in the bibliographies of existing research papers. All steps of the review were performed by only one person, although many steps of the systematic review (e.g. selection of articles), should be performed by at least one other person, independently (Tufanaru et al., 2020, p. 84). Despite the advantages of the described JBI critical appraisal tool used within this work, with regard to the use of the GRADE method in the further course of the work, the use of the Risk of Bias In Non-randomized Studies - of Interventions (ROBINS-I) tool could have been useful instead, since the GRADE tool allows the initial certainty level of an observational study to be classified directly as high under certain circumstances if the tool was used. Within the narrative synthesis, it is sometimes ambiguous whether study results were assigned to the appropriate subgroup. For example, Bai and Wunderlich (2013) examined a variable including frequency and duration of break times, the flexibility of these, and coworker support to take them. This result was categorized among the subgroup of break time, as this seemed to be the main focus of this variable studied, despite coworker support also being under study. Possibly, the variable could even have been classified as a combined variable. Another variable investigating the availability of a chair and/or space with a locked door by Lauer et al. (2019) was sub-grouped into single utility items, even though it seems difficult to delineate this with regard to the category of breastfeeding space.

5.4 Implications for Future Research

There is a need for studies assessing the impacts and effects of interventions to promote breastfeeding at the workplace on breastfeeding outcomes in Germany. This research work provides a basis for the implementation of future (quasi-)experimental, prospective studies in this context, which is needed, as cause-and-effect relationships between maternal work-related factors and breastfeeding behavior can best be assessed this way. A comprehensive, standardized national breastfeeding monitoring is needed in Germany, to make it more feasible to evaluate breastfeeding promotion interventions. However, also internationally, the quality of studies can be improved and there is a need for such studies to scale

workplace evidence-based interventions. A stronger focus on assessing the effect of previously defined, concrete interventions for breastfeeding is implied. Especially interventions including on-site child care or home-office options in high-income settings should be the subject of future research. The relationship between breastfeeding promotion measures and breastfeeding indicators such as duration of breastfeeding should be examined across multiple points in time, using longitudinal, multicentric studies in the future. Larger and more diverse samples from various settings should be involved. Above all, it is recommended to include disadvantaged population groups more in future research, i.e. those who belong to the group of women that tends to show poorer breastfeeding behavior due to their individual characteristics.

6 Conclusion

Although breastfeeding benefits mothers, children, and society, breastfeeding prevalence is low in Germany and there are deficits in breastfeeding-friendliness in many instances. One field of action that shifts further into focus by the increased need to reconcile family and career is breastfeeding promotion at the workplace. This thesis aimed to identify intervention opportunities that can be introduced in the workplace by employers. Based on a systematic review, three main intervention approaches could be identified in high-income settings that might hold promise to promote the duration of breastfeeding: adequate break time, a room for breastfeeding, and support by supervisors and colleagues. Combined measures were identified as the possibly most promising interventions. This might for example also include informational and educational components. Little to no evidence could be found for single utility items (e.g. a refrigerator) and a written breastfeeding policy at the workplace.

The intervention approaches are interdependent in several ways. However, the provision of time for breastfeeding seems to be the basic provision, whereas better breastfeeding promotion could potentially be reached by complementing this with breastfeeding facilities and/or support by supervisors and coworkers. Simultaneously, time is the field in which basic regulations are already in place in Germany. This builds a foundation for employers on which it is possible to implement further interventions to promote breastfeeding, for example granting breastfeeding breaks automatically, or beyond the mandatory specified minimum times and duration. Other than that, German employers could provide appropriate space for breastfeeding, besides the existing obligation to ensure, that women do not breastfeed under unsuitable premises. A great need for action is seen in the field of support from supervisors and colleagues in Germany. Key interventions seem to be related to increasing knowledge, linking breastfeeding with positive emotions, and exemplifying and facilitating breastfeeding-friendly behavior. These measures are to be applied to the entire workforce, in order to increase acceptance and readiness to support breastfeeding mothers. Targeted information, education, or consultation can be offered, including the benefits and recommendations for breastfeeding. Finally, workplaces vary in their requirements and pre-conditions, whereas the mentioned interventions only represent opportunities to be adapted to individual circumstances. Further improvements in the breastfeeding promotion landscape in Germany at different levels and the improvement of external support for companies could foster employers additionally in making workplaces breastfeeding-friendly in the future.

Due to the limitations of this systematic review, further and additional better-quality research is needed. No conclusions can be drawn on the effects. It is recommended to conduct implementation research and impact evaluations following stronger methodological designs than those reported in the available literature. This thesis provides a basis for this. It highlights the need for research in different fields. Above all, it is recommended to include disadvantaged population groups more in future research.

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Declaration of Independent Work

I hereby declare that I wrote this thesis without any assistance and used only the aids listed. Any material taken from other words, either as a quote or idea have been indicated under "Sources".

Bad Oldesloe, 17.07.2023,



Place / Date / Signature

Appendix

Appendix 1: Search Histories.....	XXII
Appendix 2: Data Extraction Table.....	XXIII
Appendix 3: Critical Appraisal Checklists and Explanations	XXIV

Appendix 1: Search Histories

Appendix 1 Search Histories

Search History: Medline

Date: 14/02/2023

# (No.)	Query	Filters	Results
45	#8 AND #28	English, German, Humans, from 2013 - 2023	411
32	#8 AND #28	English, German, from 2013 - 2023	518
31	#8 AND #28	English, from 2013 - 2023	516
30	#8 AND #28	from 2013 - 2023	528
29	#8 AND #28		835
28	#9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27		93,034
27	"job re-entry"[Title/Abstract]		1
26	"work re-entry"[Title/Abstract]		30
25	"job redesign"[Title/Abstract]		81
24	"work redesign"[Title/Abstract]		166
23	"job environment"[Title/Abstract]		82
22	"work* environment"[Title/Abstract]		13,77
21	"return to work"[Title/Abstract]		11,21
20	"work* condition"[Title/Abstract]		2,673
19	"work* location"[Title/Abstract]		359
18	"job-site"[Title/Abstract]		113
17	"job site"[Title/Abstract]		113
16	"work-site"[Title/Abstract]		1,273
15	"work site"[Title/Abstract]		1,273
14	"worksites"[Title/Abstract]		4,083
13	"work place"[Title/Abstract]		2,96
12	workplace*[Title/Abstract]		53,603
11	"Return to Work"[Mesh]		3,531
10	"Working Conditions"[Mesh]		72
9	"Workplace"[Mesh]		28,981
8	#2 OR #3 OR #4 OR #5 OR #6 OR #7		129,62
7	lactati*[Title/Abstract]		62,671
6	"breast feed"[Title/Abstract]		15,229
5	"breast fed"[Title/Abstract]		5,923
4	breastfe*[Title/Abstract]		47,16
3	"Lactation"[Mesh]		47,277
2	"Breast Feeding"[Mesh]		43,233

Appendix 1 Search Histories

Search History: Embase

Date: 14/02/2023

# (No.)	Query	Filters	Results
29	#28	from 2013 - 2023	439
28	#7 AND #27		648
27	#8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26		101668
26	'return to work'/exp AND [embase]/lim		7088
25	'job redesign*':ab,ti AND [embase]/lim		55
24	'job environment*':ab,ti AND [embase]/lim		80
23	'work re-entry':ab,ti AND [embase]/lim		24
22	'job re-entry':ab,ti AND [embase]/lim		3
21	'work redesign*':ab,ti AND [embase]/lim		62
20	'work* environment*':ab,ti AND [embase]/lim		13903
19	'return to work':ab,ti AND [embase]/lim		10785
18	'work* condition*':ab,ti AND [embase]/lim		11155
17	'work* location*':ab,ti AND [embase]/lim		413
16	'job-site*':ab,ti AND [embase]/lim		114
15	'job site*':ab,ti AND [embase]/lim		114
14	'work site*':ab,ti AND [embase]/lim		1017
13	'work-site*':ab,ti AND [embase]/lim		1017
12	'worksite*':ab,ti AND [embase]/lim		3000
11	'work place*':ab,ti AND [embase]/lim		3235
10	'workplace*':ab,ti AND [embase]/lim		39825
9	'work environment'/exp AND [embase]/lim		33728
8	'workplace'/exp AND [embase]/lim		33780
7	#1 OR #2 OR #3 OR #4 OR #5 OR #6		104267
6	'lactati*':ab,ti AND [embase]/lim		42368
5	'lactation'/exp AND [embase]/lim		36065
4	'breast feed*':ab,ti AND [embase]/lim		12577
3	'breast fed*':ab,ti AND [embase]/lim		6031
2	breastfe*':ab,ti AND [embase]/lim		42944
1	'breast feeding'/exp AND [embase]/lim		47094

Appendix 1 Search Histories

Search History: CINAHL

Date: 16/02/2023

# (No.)	Query	Filters	Results
51	#47 AND #48	English, German, from 2013 - 2023	486
50	#47 AND #48	from 2013 - 2023	506
49	#47 AND #48		782
48	#9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43		85749
47	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #44 OR #45 OR #46		40523
46	AB lactati*		6025
45	TU lactati*		2945
44	(MH "Lactation/ED/EI/EV/ST")		133
43	TI "work re-entry"		8
42	AB "work re-entry"		23
41	AB "job redesign**"		52
40	TI "job redesign**"		8
39	TI "job environment**"		5
38	AB "job environment**"		55
37	AB "work* environment**"		11373
36	TI "work*environment**"		2464
35	TI "work redesign**"		83
34	AB "work redesign**"		98
33	AB "job re-entry**"		6
32	TI "job re-entry**"		1
31	TI "return to work**"		2084
30	AB "return to work**"		5103
29	AB "work* condition**"		5754
28	TI "work* condition**"		954
27	TI "job-site**"		17
26	AB "job-site**"		53
25	AB "job site**"		53
24	TI "job site**"		17
23	TI "work-location**"		15
22	AB "work-location**"		165
21	AB "work-site**"		423
20	TI "work-site**"		132
19	TI "work site**"		132
18	AB "work site**"		423
17	AB "worksite**"		1747
16	TI "worksite**"		1075
15	TI "work place**"		184
14	AB "work place**"		1169
13	AB workplace*		27348
12	TI workplace*		13460
11	(MH "Job Re-Entry")		7590
10	(MH "Work Redesign")		2717

Appendix 1 Search Histories

9	(MH "Work Environment")		39013
8	TI "Breast Feed*"		1796
7	AB "Breast Feed*"		3165
6	AB "Breast Fed*"		1060
5	TI "Breast Fed*"		221
4	AB Breastfe*		17952
3	TI Breastfe*		13401
2	MH "Breast Feeding"		26723
1	MH "Breast Feeding Promotion"		4164

Appendix 1 Search Histories

Search History: Web of Science Core Collection

Date: 16/02/2023

# (No.)	Query	Filters	Results
23	#17 AND #22	English, German, from 2013 - 2023	533
22	#18 OR #19 OR #20 OR #21		126695
21	breastfe* (Topic)		33860
20	TS=("breast fed*")		5595
19	TS=("breast feed*")		12548
18	lactati* (Topic)		87012
17	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16		166044
16	workplace* (Topic)		93668
15	"work place*" (Topic)		3870
14	worksite* (Topic)		4409
13	"work site*" (Topic)		1435
12	"work-site*" (Topic)		1435
11	"job-site*" (Topic)		393
10	"job site*" (Topic)		393
9	"work* location*" (Topic)		972
8	"work* condition*" (Topic)		37052
7	"work* environment*" (Topic)		30108
6	"job environment*" (Topic)		162
5	"return to work" (Topic)		10369
4	"work redesign*" (Topic)		173
3	"job redesign*" (Topic)		190
2	"job re-entry*" (Topic)		9
1	"work re-entry*" (Topic)		26

Appendix 1 Search Histories

Search History: CENTRAL

Date: 13/02/2023

# (No.)	Query	Filters	Results
27	#6 AND #26	Jan. 2013 - Mar. 2023	33
26	#7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25		7048
25	MeSH descriptor: [Return to Work] explode all trees		310
24	MeSH descriptor: [Working Conditions] explode all trees		0
23	("job re-entry"):ti,ab,kw		24
22	("work re-entry"):ti,ab,kw		1
21	("work redesign*"):ti,ab,kw		6
20	("job redesign*"):ti,ab,kw		2
19	("job environment*"):ti,ab,kw		2
18	("work* environment*"):ti,ab,kw		648
17	("return to work"):ti,ab,kw		2473
16	("work* condition*"):ti,ab,kw		60
15	("work* location*"):ti,ab,kw		13
14	("work-site*"):ti,ab,kw		144
13	("work site*"):ti,ab,kw		144
12	(worksites*):ti,ab,kw		1003
11	(workplace*):ti,ab,kw		3640
10	("work place*"):ti,ab,kw		176
9	(job-site*):ti,ab,kw		8
8	("Job Site*"):ti,ab,kw		5
7	MeSH descriptor: [Workplace] explode all trees		1144
6	#1 OR #2 OR #3 OR #4 OR #5		12894
5	(breastfe*):ti,ab,kw		8206
4	MeSH descriptor: [Breast Feeding] explode all trees		2437
3	(lactati*):ti,ab,kw		5248
2	("breast fed*"):ti,ab,kw		829
1	("breast feed*"):ti,ab,kw		207

Appendix 2: Data Extraction Table

Appendix 2 Data Extraction Table

Author, year, country	Study participants, type of worksite, demographic characteristics and other determinants	Study design, type of analysis	Independent variable	Outcome variable and statistical results
<p>Bai & Wunderlich, 2013, USA</p>	<p>Study participants (N¹=113): Working mothers aged ≥18 years who are currently BF² or had BF within 18 months prior to the beginning of the study</p> <p>Recruitment: via higher education institution and obstetric clients of a hospital in New Jersey</p> <p>Worksite: educational institutions (31%), health care (23%), and others (46.1%), e.g. government, media, corporate company, and retail</p> <p>Demographic characteristics and other determinants:</p> <ul style="list-style-type: none"> ▪ A.³ 33.8 (6.0) ▪ E.⁴ high school (2.7%), some college (15.0%), college graduate (40.7%), postgraduate (41.6%) 	<p>Cross-sectional design, survey</p> <p>Correlations (Spearman)</p>	<p>(1) Technical support (availability of a refrigerator, rental breast pumps, and on-site day care)</p> <p>(2) Workplace environment (commonness of breastfeeding in the workplace, supervisor/peer support, and a quiet space other than the bathroom for pumping when needed)</p> <p>(3) Break time (frequency and duration of breaks, flexibility, and coworker support)</p> <p>(4) Workplace policies (availability of written policy in the workplace regarding breastfeeding and the duration of maternity leave)</p>	<p>EBF⁸ duration</p> <p>(1) Technical support: $r(111)=.71, p^9=.01$</p> <p>(2) Workplace environment: $r(111)=.26, p=.01$</p> <p>(3) Break time: $r(111)=.05, p=.52$ (NS¹⁰)</p> <p>(4) Workplace policies: $r(111)=.13, p=.24$ (NS)</p>

¹ Number of study participants

² Breastfeeding

³ Maternal age, mean (SD) in years

⁴ Education

⁸ Exclusive breastfeeding

⁹ A p-value of ≤.05 is defined as significant within this systematic review

¹⁰ Not significant

Appendix 2 Data Extraction Table

Author, year, country	Study participants, type of worksite, demographic characteristics and other determinants	Study design, type of analysis	Independent variable	Outcome variable and statistical results
	<ul style="list-style-type: none"> ▪ M.⁵ married (92%), single (8%) ▪ P.⁶ primiparous (59.8%), multiparous (40.2%) ▪ WIC participation yes (6.2%), no (93.8%) ▪ W.⁷ full-time (69.1%), part-time (30.9%) 			
Kozhimannil et al., 2016, USA	<p>Study participants (N=550): Women aged 18-45 who were employed at the time of the follow-up postpartum survey between January and April 2013</p> <p>Recruitment: Listening to Mothers III survey of women who gave birth in U.S. hospital between July 2011 and June 2012</p> <p>Worksite: N/A¹¹</p> <p>Demographic characteristics and other determinants:</p> <ul style="list-style-type: none"> ▪ AC.¹² 18-24 (27.5%), 25-29 (25.9%), 30-34 (26.8%), 35+ (19.7%) 	<p>Cross-sectional design, survey</p> <p>Multivariate logistic regression, Multivariate cox proportional hazards ratios (survival analysis)</p>	<p>(1) Breastfeeding break times</p> <p>(2) Private breastfeeding space</p>	<p>AOR¹⁵ of EBF at 6 months</p> <p>(1) Reasonable break time to express milk: 2.593, 95% CI: 1.00–6.71, p<.05</p> <p>(2) Private space: 2.669, 95% CI: 0.43–16.48, np p-value reported (NS)</p> <p>(1 & 2) Break time + private space: 2.255, 95% CI: 1.03–4.95, p<.05</p>

⁵ Marital status

⁶ Parity (number of children to which a woman has given birth)

⁷ Work status (full- or part-time)

¹¹ Not available (was not reported/ surveyed within the study)

¹² Age category in years

¹⁵ adjusted odds ratio

Appendix 2 Data Extraction Table

Author, year, country	Study participants, type of worksite, demographic characteristics and other determinants	Study design, type of analysis	Independent variable	Outcome variable and statistical results
	<ul style="list-style-type: none"> ▪ E. high school or less (26.3%), some college (28.4%), Bachelor's degree (27.3%), Graduate education/degree (18.0%) ▪ M. no partner (6.1%), unmarried with partner (26.5%), married (67.4%) ▪ I.¹³ ≤\$52300 (32.3%), \$52301-\$102000 (47.4%), >\$102001 (20.3%) ▪ D.¹⁴ vaginal (71.6%), cesarean (28.4%) ▪ Baby was in neonatal intensive care unit (NICU) (19.9%) 			<p>AOR of any BF at 6 months</p> <p>(1) Reasonable break time to express milk: 3.004, 95% CI: 1.23–7.32, p<.05</p> <p>(2) Private space to express milk: 0.555, 95% CI: 0.12–2.57, no p-value reported (NS)</p> <p>(1 & 2) Break time + private space: 1.946, 95% CI: 0.88–4.28, no p-value reported (NS)</p> <p>Hazard Ratio of duration of EBF</p> <p>(1) Reasonable break time to express milk: 1.098, 95% CI: 0.72-1.67, no p-value reported (NS)</p> <p>(2) Private space: 3.813, 95% CI: 1.41-10.34, p<.01</p> <p>(1 & 2) Break time + private space: 1.450, 95% CI: 1.08-2.06, p<.05</p> <p>Hazard Ratio of duration of any BF</p> <p>(1) Reasonable break time to express milk: 1.232, 95% CI: 0.88-1.232, no p-value reported (NS)</p> <p>(2) Private space: 0.901, 95% CI: 0.45-1.81, no p-value reported (NS)</p> <p>(1 & 2) Break time + private space: 1.174, 95% CI: 0.83-1.66, no p-value reported (NS)</p>
Alvarez et al., 2015, USA	<p>Study participants (N=29): Female lawyers having one biological child</p> <p>Worksite and recruitment: University</p>	<p>Cross-sectional design, survey</p> <p>Correlations (Spearman)</p>	<p>(1) BF support from colleagues</p> <p>(2) Appropriate place at work for breastfeeding</p> <p>(3) Sufficient time at work for breastfeeding breaks</p>	<p>Duration of EBF:</p> <p>(1) BF support from colleagues: $r(27)=.402$, p=.031</p> <p>(2) Breastfeeding space: N/A</p> <p>(3) Breastfeeding breaks: $r(27)=.462$, p=.030</p>

¹³ Income per annum

¹⁴ Mode of delivery

Appendix 2 Data Extraction Table

Author, year, country	Study participants, type of worksite, demographic characteristics and other determinants	Study design, type of analysis	Independent variable	Outcome variable and statistical results
	<p>Demographic characteristics and other determinants:</p> <ul style="list-style-type: none"> ▪ A. 34.6 (6.2) ▪ M. married (87%), not married (13%) ▪ P. primiparous (100%) ▪ W. full-time employment postpartum (23%) ▪ Average length of maternity leave in weeks (mean, SD¹⁶): 11.4±12.9 ▪ Average duration of paid maternity leave in weeks (mean, SD): 6.3±5.9 			<p>Duration of any BF:</p> <p>(1) BF support from colleagues: $r(27)=-.448$, $p=.032$</p> <p>(2) Breastfeeding space: $r(27)=-.504$, $p=.039$</p> <p>(3) Breastfeeding breaks: $r(27)=-.493$, $p=.044$</p>
<p>Nakada, 2021, Japan</p>	<p>Study participants (N=141):</p> <p>Program group ($n=48$) and pamphlet group ($n=46$): Japanese-speaking women who planned to return to work within 4-12 months after giving birth and who were BF at the time of recruitment.</p> <p>Comparison group ($n=47$): Japanese-speaking women who returned to work within 4-12 months after giving birth, had been back at work for at least 3 months and were breastfeeding before returning to work.</p> <p>Recruitment: via medical and childcare facilities near the program venue</p> <p>Worksite: N/A (diverse)</p>	<p>Non-randomized controlled trial (quasi-experimental design)</p> <p>Chi-square-test, Logistic regression</p>	<p>(1) Program group (interventions delivered before returning to work):</p> <ul style="list-style-type: none"> ▪ Breastfeeding class (90min), ▪ Use of pamphlet, ▪ Distribution of a newsletter upon return to work and ▪ Email consultation up to three months after returning to work. <p>(2) Pamphlet group</p> <ul style="list-style-type: none"> ▪ Pamphlet was sent before returning to work <p>(3) Comparison group</p> <ul style="list-style-type: none"> ▪ No measures 	<p>BF continuation (BF at least once a day) rate at 3 months after returning to work:</p> <p>(1 vs. 3) Program group vs. comparison group: 79.2% vs. 51.1%, $p=.004$</p> <p>(2 vs. 3) Pamphlet group vs. comparison group: 69.6% vs. 51.5%, $p=.07$ (NS)</p> <p>AOR for BF continuation (BF at least once a day) 3 months after returning to work:</p> <p>(1) Program intervention: 4.68, 95% CI: 1.57-13.96, $p=.006$</p>

¹⁶ Standard deviation

Appendix 2 Data Extraction Table

Author, year, country	Study participants, type of worksite, demographic characteristics and other determinants	Study design, type of analysis	Independent variable	Outcome variable and statistical results
	<p>Demographic characteristics and other determinants:</p> <ul style="list-style-type: none"> ▪ A. program group: 34.0 (3.5); pamphlet group: 34.8 (3.9); comparison group: 34.2 (3.9) ▪ E. program group: university or college graduate (97.9%), junior high or high school graduate (2.1%); pamphlet group: university or college graduate (95.7%), junior high or high school graduate (4.3%); comparison group: university or college graduate (85.1%), junior high or high school graduate (14.9%) ▪ P. program group: primiparous (70.8%), multiparous (29.2%); pamphlet group: primiparous (69.6%), multiparous (30.4%); comparison group: primiparous (51.1%), multiparous (48.9%) ▪ W. program group: full-time (87.5%), part-time (12.5%); pamphlet group: full-time (78.3%), part-time (21.7%); comparison group: full-time (74.5%), part-time (25.5%) 			

Appendix 2 Data Extraction Table

Author, year, country	Study participants, type of worksite, demographic characteristics and other determinants	Study design, type of analysis	Independent variable	Outcome variable and statistical results
	<ul style="list-style-type: none"> S.¹⁷ program group: yes (100%); pamphlet group: yes (100%); comparison group: yes (97.8%), no (2.2%) 			
Tsai, 2013, China	<p>Study participants (N=715): Female employees who have taken maternity leave between January 2009 and January 2011</p> <p>Worksite and recruitment: electronics manufacturing company (size: >20,000 employees): clean room (44.8%), office (55.2%)</p> <p>Demographic characteristics and other determinants:</p> <ul style="list-style-type: none"> AC. 20-29 (23.9%), 30-39 (74.6%), ≥40 (1.5%) E. High school education and below (28.3%), college and above (74.3%) Shift work: yes (46.7%) Work hours per day: 8 (15.7%), 9-14 (83.3%) 	<p>Cross-sectional design, survey</p> <p>Multivariate logistic regression</p> <p>(reference group: women that were categorized as not continuing to breastfeed after returning to work, definition: working mothers who did not breastfeed at the beginning of maternity leave and breastfed for less than 1 month after returning to work)</p>	<p>(1) Use of breastfeeding breaks (yes vs. no)</p> <p>(2) Encouragement and support for breastfeeding at the workplace by colleagues (yes vs. no)</p> <p>(3) Encouragement and support for breastfeeding at the workplace by supervisor (yes vs. no)</p> <p>(4) Access to breastfeeding room (independent space vs. no independent space)</p> <p>(5) Awareness of breastfeeding breaks (yes vs. no)</p>	<p>OR¹⁸ for continued BF for 1–6 months after return to work:</p> <p>(1) Using breastfeeding breaks: 33.1, 95% CI: 18.0–64.1, p<.0001</p> <p>(2) Supportive colleagues: 2.53, 95% CI: 2.21–5.32, p=.0133</p> <p>(3) Supportive supervisor: 2.45, 95% CI: 1.17–5.05, p=.0156</p> <p>(4) Access (independent) breastfeeding space: 1.17, 95% CI: 0.51-2.75, p=.7049 (NS)</p> <p>(5) Awareness of breastfeeding breaks: 1.09, 95% CI: 0.62-1.95, p=.7498 (NS)</p> <p>OR for continued BF for > 6 months after return to work:</p> <p>(1) Using breastfeeding breaks: 51.6, 95% CI: 31.2–121.6, p<.0001</p> <p>(2) Supportive colleagues: 2.78, 95% CI: 1.14–6.76, p=.0235</p> <p>(3) Supportive supervisor: 2.44, 95% CI: 1.06–5.61, p=.0355</p> <p>(4) Access to (independent) breastfeeding space: 2.38, 95% CI: 1.14–6.32, p=.0284</p>

¹⁷ Smoking status

¹⁸ Odds ratio

Appendix 2 Data Extraction Table

Author, year, country	Study participants, type of worksite, demographic characteristics and other determinants	Study design, type of analysis	Independent variable	Outcome variable and statistical results
				(5) Awareness of breastfeeding breaks: 0.87, 95% CI: 0.43-1.73, $p=.6921$ (NS)
Lauer, 2019, USA	<p>Study participants (N=682): Women or their children or birth mother of their children being enrolled in the WIC¹⁹ program.</p> <p>Recruitment: via referrals from WIC staff and flyers in the WIC offices</p> <p>Worksite: accomodation (22.8%), healthcare (25.2%), retail (17.6%), other (34.4%)</p> <p>Demographic characteristics and other determinants:</p> <ul style="list-style-type: none"> ▪ AC. 15-17 (0.6%), 18-34 (74.9%), ≥35 (12.6%), not reported (12.0%) ▪ W. full-time (26.9%), part-time (25.6%), other (47.2%) 	<p>Cross-sectional design, survey</p> <p>Fisher's exact test (or Fisher's exact tests with Freeman and Halton's adaption)</p>	<p>Policies and culture:</p> <p>(1) Policy on BF or pumping (2) Provision of pumping break times (3) Flexibility of those break times</p> <p>Physical Environment and safety climate:</p> <p>(4) Private pumping space available (5) Onsite items provided: Utilities (electrical outlet and/ or nearby sink) (6) Onsite items provided: Physical (chair and/ or space with locked door) (7) Supportive Coworkers (8) Supportive supervisors</p>	<p>BF duration (4 months or longer vs. less than 4 months):</p> <p>Policies and culture:</p> <p>(1) BF or pumping policy (yes): 13.3% vs. 8.3%, $p=0.240$ (NS)</p> <p>(2) Pumping break times (yes): 53.3% vs. 39.8%, $p=.032$</p> <p>(3) Flexible breaks (yes): 92.1% vs. 76.2%, $p=.077$ (NS)</p> <p>Physical Environment and safety climate:</p> <p>(4) Private pumping space (yes): 46.2% vs. 33.0%, $p=.035$ (NS after Bonferroni correction)</p> <p>(5) Onsite Items: Utilities (yes): 85.9% vs. 69.5%, $p=.022$ (NS after Bonferroni correction)</p> <p>(6) Onsite Items: Physical (yes): 89.4% vs. 96.6%, $p=.200$ (NS)</p> <p>(7) Supportive Coworkers (yes): 56.2% vs. 46.6%, $p=.289$ (NS)</p> <p>(8) Supportive supervisors (yes): 58.7% vs. 46.1%, $p=.155$ (NS)</p>
Sattari et al. 2013, USA	<p>Study participants (N=130): Female physicians having at least one biological child, being or having completed training.</p>	<p>Cross-sectional design, survey</p>	<p>(1a-c) Perception of level of enhanced support:</p> <p>(1a) collegial support (always supportive compared with usually supportive) (1b) Program director or chief (always</p>	<p>Estimated effect on BF duration in months:</p> <p>(1a) 1.3 increase 95% CI: 0.366-2.25 ($r=.19$, $p=.011$) for each one unit increase in collegial support</p>

¹⁹Women, Infants and Children

Appendix 2 Data Extraction Table

Author, year, country	Study participants, type of worksite, demographic characteristics and other determinants	Study design, type of analysis	Independent variable	Outcome variable and statistical results
	<p>Worksite and recruitment: Academic Institutions: Johns Hopkins University School of Medicine ($n = 50$; 38.5%) and the University of Florida College of Medicine ($n = 80$; 61.5%)</p> <p>Demographic characteristics and other determinants:</p> <ul style="list-style-type: none"> ▪ A. 37.6 (6.7) ▪ M. married (93.1%), other (6.9%) ▪ P. primiparous (36.2%), multiparous (63.8%) ▪ Specialty: surgical (35.4%), non-surgical (64.6%) 	Multivariate analysis: Mixed linear model	<p>supportive compared with usually supportive)</p> <p>(1c) special favors by colleagues (Participants reporting they encountered non-support at work due to perceived special favors by their colleagues compared with participants who did not report perceived special favors by their colleagues)</p> <p>(2) availability of time at work for milk expression (reported as occasionally compared with never)</p>	<p>(1b) 1.1 increase 95% CI: 0.263-1.90 (no r reported, $p=.010$) for each one unit increase in support from program director or chief</p> <p>(1c) 3.5 decrease 95% CI: -6.77- -0.145 (no r reported, $p=.037$) for those that perceived lack of support for BF at work (due to perceived special favors by colleagues)</p> <p>(2) 1.1 increase 95% CI: not reported ($r=0.29$, $p<.0001$) for each increase in score in reported availability of time at work for milk expression</p>
Cervera-Gasch et al., 2020, Spain	<p>Study participants (N=301): Female teachers/researchers or administration/service staff who gave birth in the past 10 years</p> <p>Worksite and recruitment: UJ²⁰ (case, $N=103$) or UdS²¹ (control, $N=198$), each including administration/service personnel and teacher/researcher in about same proportions</p> <p>Demographic characteristics and other determinants:</p> <ul style="list-style-type: none"> ▪ E. UJ: primary education (0%), secondary education (1%), university studies (99%); UdS: primary education (1%), secondary 	Case-control design Chi-square-test with Fisher's correction whenever necessary	<p>(1) UJ:</p> <ul style="list-style-type: none"> ▪ 4 designated BF areas ▪ BF education (incl. matters like benefits of BF, pumping/ preserving/ storing breast milk and experience) <p>(2) UdS:</p> <ul style="list-style-type: none"> ▪ No breastfeeding room and ▪ No breastfeeding support program 	<p>Continued BF after return to work: 71.8% (UJ) vs. 50.5% (UdS), $p=.001$</p> <p>BF duration ($p<.0001$):</p> <p>(1) UJ:</p> <ul style="list-style-type: none"> ▪ 15.5% < 6 months, ▪ 13.6% 6-12 months, ▪ 28.2% 1-2 years, ▪ 32.0% > 2 years ▪ 0.0% currently BF

²⁰ University Jaume

²¹ University de Sevilla

Appendix 2 Data Extraction Table

Author, year, country	Study participants, type of worksite, demographic characteristics and other determinants	Study design, type of analysis	Independent variable	Outcome variable and statistical results
	<p>education (11.1%), university studies (87.9%)</p> <ul style="list-style-type: none"> ▪ Have a partner UJ: yes (99%), UdS: yes (92.9%) ▪ P. UJ: primiparous (42.7%), multiparous (57.3%); UdS: primiparous (22.2%), multiparous (77.8%) ▪ D. UJ: vaginal (67%), cesarean (33%); UdS: vaginal (74.7%), cesarean (24.7%) ▪ Maternity leave length in weeks. UJ: 6 (3.9%), 7-11 (3.9%), 12-16 (25.2%), >16 (57.3%); UdS: 6 (1.5%), 7-11 (3%), 12-16 (21.7%), >16 (58.6%) 			<p>(2) UdS:</p> <ul style="list-style-type: none"> ▪ 39.9% < 6 months, ▪ 18.2% 6-12 months, ▪ 16.7% 1-2 years, ▪ 10.6% > 2 years, ▪ 4.0% currently BF
<p>Huang et al., 2023, China</p>	<p>Study participants (N=1,243): Postpartum, breastfeeding women older than 18 years employed full-time and having healthy infants less than 2 years of age.</p> <p>Recruitment: from community health service centers and pediatric out-patient units of comprehensive large hospitals in five different provinces</p> <p>Worksite: N/A (diverse)</p> <p>Demographic characteristics and other determinants:</p> <ul style="list-style-type: none"> ▪ A. 26.2 (3.2) 	<p>Cross-sectional, survey</p> <p>Multiple linear regression</p>	<p>WBSS²² score: Measures mother's perception of support for BF in the workplace. It includes 12 items with four dimensions:</p> <ul style="list-style-type: none"> ▪ Technical support ▪ Environmental support ▪ Facility support ▪ Peer support 	<p>Duration of any BF:</p> <p>Adjusted R²= .178, F=16.872, p<.001</p> <p>B=.04, 95% CI=0.023-0.053, SE=.01, β=0.133, p<.001</p>

²² Workplace Breastfeeding Support Scale

Appendix 2 Data Extraction Table

Author, year, country	Study participants, type of worksite, demographic characteristics and other determinants	Study design, type of analysis	Independent variable	Outcome variable and statistical results
	<ul style="list-style-type: none"> ▪ P. primiparous (82.3%), multiparous (17.7%) ▪ D. vaginal (88.3%), cesarean (11.7%) ▪ Average length of maternity leave in months (mean, SD): 5.3±0.8 			
Melnitchouk et al., 2018, USA	<p>Study participants (N = 1,606): physician mothers currently not BF</p> <p>Recruitment: social media (PhysicianMomsGroup)</p> <p>Worksite: Different practice types (41.2% academic, 21.9% community, 31.9% private, 4.5% other)</p> <p>Demographic characteristics and other determinants:</p> <ul style="list-style-type: none"> ▪ AC. 25-30 (4.7%), 31-35 (50.2%), 36-40 (36.9%), >40 (8.2%) ▪ P. primiparous (39.6%), multiparous (64.8%) ▪ Specialty: surgical (27.8%), non-surgical (72.2%) 	<p>Cross-sectional, survey</p> <p>Multivariate logistic regression</p>	<p>(1) Access to dedicated private space to lactate</p> <p>(2) Schedule adjusted to allow for breastfeeding breaks</p>	<p>AOR of BF for 12 months or longer:</p> <p>(1) Private space: 1.23, 95% CI: 0.99-1.52, <i>p</i>=.42 (NS)</p> <p>(2) Schedule allows for breastfeeding: 1.58, 95% CI: 1.26-1.98, <i>p</i><.001</p> <p>AOR of BF to personal goal:</p> <p>(1) Private space: 1.44, 95% CI: 1.14-1.81, <i>p</i>=.002</p> <p>(2) Schedule allows for breastfeeding: 1.60, 95% CI: 1.24-2.00, <i>p</i><.001</p>
Spitzmueller et al., 2016, USA	<p>Study participants (N=859): Women aged between 18-45 who gave birth within the past two years and returned to the same workplace they were employed at in pregnancy within the first year of infant's life and women who were BF when they returned to work.</p> <p>Recruitment: via child care centers across a large city in the Southern United States</p>	<p>Cross-sectional, survey</p> <p>Cox proportional hazards regression (survival analysis)</p>	<p>(1) Negative remarks about BF from</p> <ul style="list-style-type: none"> ▪ their supervisors or ▪ coworkers <p>(2) Instrumental BF support:</p> <ul style="list-style-type: none"> ▪ Sufficient break time ▪ Convenient space suitable for breastfeeding 	<p>Duration of continuation of BF during the first 12 months of the infant's life:</p> <p>(1) Negative remarks:</p> <ul style="list-style-type: none"> ▪ Supervisor negative comments: <i>B</i>=0.24, Wald=0.20, <i>p</i>=.65 (NS) ▪ Coworker negative comments: <i>B</i>=-0.28, Wald=0.67, <i>p</i>=.41 (NS)

Appendix 2 Data Extraction Table

Author, year, country	Study participants, type of worksite, demographic characteristics and other determinants	Study design, type of analysis	Independent variable	Outcome variable and statistical results
	<p>Worksite: N/A (diverse)</p> <p>Demographic characteristics and other determinants:</p> <ul style="list-style-type: none"> ▪ A. 29.79 (5.22) ▪ E. high school or less (10%), some college (34%), college graduate (39%) ▪ M. married (83%) ▪ P. primiparous (100%) 		<ul style="list-style-type: none"> ▪ Refrigeration options for expressed milk <p>(3) Women's perceptions of workplace support for BF after they return to work</p>	<p>(2) Instrumental BF support:</p> <ul style="list-style-type: none"> ▪ Break time: $B=0.19$, $Wald=1.47$, $p=.23$ (NS) ▪ Space: $B=-0.19$, $Wald=0.97$, $p=.33$ (NS) ▪ Refrigeration options: $B=-0.14$, $Wald=0.20$, $p=.66$ (NS) <p>(3) Perceptions for BF support: $B=-0.11$, $Wald=1.24$, $p=.27$ (NS)</p> <p>Duration of EBF during the first 6 months of the infant's life:</p> <p>(1) Negative remarks:</p> <ul style="list-style-type: none"> ▪ Supervisor negative comments: $B=2.09$, $Wald=9.86$, $p=.002$ (OR: 8.10) ▪ Coworker negative comments: $B=-0.84$, $Wald=3.21$, $p=.07$ (NS) <p>(2) Instrumental BF support:</p> <ul style="list-style-type: none"> ▪ Break time: $B=-0.01$, $Wald=0.00$, $p=.96$ (NS) ▪ Space: $B=-0.45$, $Wald=2.59$, $p=.11$ (NS) ▪ Refrigeration options: $B=0.69$, $Wald=2.60$, $p=.11$ (NS) <p>(3) Perceptions for BF support: $B=-0.35$, $Wald=6.59$, $p=.01$ (OR=0.70)</p>
<p>Bono & Pronzato, 2022, UK</p>	<p>Study participants (N=3,094): Working mothers with singleton births who have ever breastfed</p> <p>Recruitment: via UK Infant Feeding Survey carried out in 2005; mothers were selected from all births registered during August and September/October of the relevant year in all UK countries.</p>	<p>Cross-sectional, survey</p> <p>Correlations (Spearman)</p>	<p>(1) Facilities to express milk</p> <p>(2) Facilities to breastfeed</p> <p>(3) Availability of extended breaks</p> <p>(4) Any BF facilities</p>	<p>BF at 4 months postpartum:</p> <p>(1) Facilities to express milk: $r(3,092)=0.460$, $p<.01$</p> <p>(2) Facilities to breastfeed: $r(3,092)=0.195$, $p>.05$ (NS)</p> <p>(3) Availability of extended breaks: $r(3,092)=0.050$, $p>.05$ (NS)</p> <p>(4) Any BF facilities: $r(3,092)=0.517$, $p<.01$</p>

Appendix 2 Data Extraction Table

Author, year, country	Study participants, type of worksite, demographic characteristics and other determinants	Study design, type of analysis	Independent variable	Outcome variable and statistical results
	<p>Worksite: Manager and professional (11.2%), associate professional (16%), administrative and secretarial (22%), skilled trades and personal services (19.5%), sales and customer services (14.7%), plant, machine and elementary operators (11.5%), missing occupational code (5.1%); firm size in number of employees: 1-24 (34%), 25-499 (41.6%), ≥500 (23.5%), missing (0.8%)</p> <p>Demographic characteristics and other determinants:</p> <ul style="list-style-type: none"> ▪ AC. <30 (44.9%), ≥30 (55.1%) ▪ E. lower educated (50.6%), higher educated (50.6%) ▪ M. married (64%), living with partner (27.7%), other marital status (6.7%), single (0.7%) ▪ P. Number of children on average (mean, SD): 1.5±0.72; 60% were first born, only singleton births ▪ S. smoke in pregnancy yes (10.2%), no (87.2%) ▪ D. vaginal (75%), cesarean (25%) 			<p>BF at 6 months postpartum:</p> <p>(1) Facilities to express milk: $r(3,092)=0.526$, $p<.01$</p> <p>(2) Facilities to breastfeed: $r(3,092)=0.269$, $p<.05$</p> <p>(3) Availability of extended breaks: $r(3,092)=0.230$, $p>.05$ (NS)</p> <p>(4) Any BF facilities: $r(3,092)=0.592$, $p<.01$</p>
<p>Smith et al., 2013, Australia</p>	<p>Study participants (N=304): Employee mothers who initiated BF and returned to work within 2 years after their child's birth</p>	<p>Cross-sectional design, survey</p> <p>Chi-square-test</p>	<p>(1) Possibility to take long enough, or frequent enough, breastfeeding breaks</p> <p>(2) Organization has written policy of supporting mothers who express breast milk or breastfeed at work</p>	<p>EBF at 6 months of infant's age:</p> <p>(1) Breastfeeding breaks possible: 70% (yes), 36% (no), $p=.077$ (NS)</p> <p>(2) Written BF policy available: 61% (yes), 34% (no), $p=.16$</p>

Appendix 2 Data Extraction Table

Author, year, country	Study participants, type of worksite, demographic characteristics and other determinants	Study design, type of analysis	Independent variable	Outcome variable and statistical results
	<p>Recruitment: via 207 employing organizations (73 that had received accreditation as breastfeeding friendly workplace, 25 that had applied for accreditation, 109 that had neither received or applied)</p> <p>Worksites: Manager professional (62.3%), clerical/administrative, community/personal services, sales workers (37.6%)</p> <p>More specifically: Government administration and defence (30%), education, health and community services (28%), property and business services (14%), finance and insurance (11%), communication, electricity, gas and water supply (6%), manufacturing (6%), cultural and recreational services (5%); size: Small with <20 staff (13%), medium with 20-200 staff (39%), large with >200 staff (48%); ownership public (43%), private (57%)</p> <p>Demographic characteristics and other determinants:</p> <ul style="list-style-type: none"> ▪ AC. ≤29 (13.7%), 30-34 (48%), 35-39 (29.3%), ≥40 (9%) ▪ E. post-secondary (77%) ▪ I. ≤\$31,199 (2.7%), \$31,200-51,999 (5%), \$52,000-77,999 (15.3%), \$78,000-114,399 (30.2%), ≥\$114,400 (47.3%) 		<p>(3) Manager/supervisor and colleagues think more poorly of workers who express breast milk or breastfeed at work</p>	<p>(3) Negative mindset/ lack of BF support by supervisor or colleagues: 43% (agree), 57% (disagree), 29% (neither agree nor disagree), $p=.075$ (NS)</p> <p>Degrees of freedom and chi-square statistic value were not reported.</p>

Appendix 3: Critical Appraisal Checklists and Explanations

JBI CRITICAL APPRAISAL CHECKLIST FOR ANALYTICAL CROSS SECTIONAL STUDIES

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the study subjects and the setting described in detail?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Was the exposure measured in a valid and reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Were objective, standard criteria used for measurement of the condition?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were confounding factors identified?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Were strategies to deal with confounding factors stated?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were the outcomes measured in a valid and reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Was appropriate statistical analysis used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: Include Exclude Seek further info

Comments (Including reason for exclusion)

EXPLANATION OF ANALYTICAL CROSS SECTIONAL STUDIES CRITICAL APPRAISAL

How to cite: Moola S, Munn Z, Tufanaru C, Aromataris E, Sears K, Sfetcu R, Currie M, Qureshi R, Mattis P, Lisy K, Mu P-F. Chapter 7: Systematic reviews of etiology and risk . In: Aromataris E, Munn Z (Editors). *JBIManual for Evidence Synthesis*. JBI, 2020. Available from <https://synthesismanual.jbi.global>

Analytical cross sectional studies Critical Appraisal Tool

Answers: Yes, No, Unclear or Not/Applicable

1. Were the criteria for inclusion in the sample clearly defined?

The authors should provide clear inclusion and exclusion criteria that they developed prior to recruitment of the study participants. The inclusion/exclusion criteria should be specified (e.g., risk, stage of disease progression) with sufficient detail and all the necessary information critical to the study.

2. Were the study subjects and the setting described in detail?

The study sample should be described in sufficient detail so that other researchers can determine if it is comparable to the population of interest to them. The authors should provide a clear description of the population from which the study participants were selected or recruited, including demographics, location, and time period.

3. Was the exposure measured in a valid and reliable way?

The study should clearly describe the method of measurement of exposure. Assessing validity requires that a 'gold standard' is available to which the measure can be compared. The validity of exposure measurement usually relates to whether a current measure is appropriate or whether a measure of past exposure is needed.

Reliability refers to the processes included in an epidemiological study to check repeatability of measurements of the exposures. These usually include intra-observer reliability and inter-observer reliability.

4. Were objective, standard criteria used for measurement of the condition?

It is useful to determine if patients were included in the study based on either a specified diagnosis or definition. This is more likely to decrease the risk of bias. Characteristics are another useful approach to matching groups, and studies that did not use specified diagnostic methods or definitions should provide evidence on matching by key characteristics

5. Were confounding factors identified?

Confounding has occurred where the estimated intervention exposure effect is biased by the presence of some difference between the comparison groups (apart from the exposure investigated/of interest). Typical confounders include baseline characteristics, prognostic factors, or concomitant exposures (e.g. smoking). A confounder is a difference between the comparison groups and it influences the direction of the study results. A high quality study at the level of cohort design will identify the potential confounders and measure them (where possible). This is difficult for studies where behavioral, attitudinal or lifestyle factors may impact on the results.

6. Were strategies to deal with confounding factors stated?

Strategies to deal with effects of confounding factors may be dealt within the study design or in data analysis. By matching or stratifying sampling of participants, effects of confounding factors can be adjusted for. When dealing with adjustment in data analysis, assess the statistics used in the study. Most will be some form of multivariate regression analysis to account for the confounding factors measured.

7. Were the outcomes measured in a valid and reliable way?

Read the methods section of the paper. If for e.g. lung cancer is assessed based on existing definitions or diagnostic criteria, then the answer to this question is likely to be yes. If lung cancer is assessed using observer reported, or self-reported scales, the risk of over- or under-reporting is increased, and objectivity is compromised. Importantly, determine if the measurement tools used were validated instruments as this has a significant impact on outcome assessment validity.

Having established the objectivity of the outcome measurement (e.g. lung cancer) instrument, it's important to establish how the measurement was conducted. Were those involved in collecting data trained or educated in the use of the instrument/s? (e.g. radiographers). If there was more than one data collector, were they similar in terms of level of education, clinical or research experience, or level of responsibility in the piece of research being appraised?

8. Was appropriate statistical analysis used?

As with any consideration of statistical analysis, consideration should be given to whether there was a more appropriate alternate statistical method that could have been used. The methods section should be detailed enough for reviewers to identify which analytical techniques were used (in particular, regression or stratification) and how specific confounders were measured.

For studies utilizing regression analysis, it is useful to identify if the study identified which variables were included and how they related to the outcome. If stratification was the analytical approach used, were the strata of analysis defined by the specified variables? Additionally, it is also important to assess the appropriateness of the analytical strategy in terms of the assumptions associated with the approach as differing methods of analysis are based on differing assumptions about the data and how it will respond.

JBI CRITICAL APPRAISAL CHECKLIST FOR QUASI-EXPERIMENTAL STUDIES

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not applicable
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the participants included in any comparisons similar?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Was there a control group?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were the outcomes of participants included in any comparisons measured in the same way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Were outcomes measured in a reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Was appropriate statistical analysis used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: Include Exclude Seek further info

Comments (Including reason for exclusion)

EXPLANATION FOR THE CRITICAL APPRAISAL TOOL FOR QUASI-EXPERIMENTAL STUDIES

How to cite: Tufanaru C, Munn Z, Aromataris E, Campbell J, Hopp L. Chapter 3: Systematic reviews of effectiveness. In: Aromataris E, Munn Z (Editors). *JBIM Manual for Evidence Synthesis*. JBI, 2020. Available from <https://synthesismanual.jbi.global>

Critical Appraisal Tool for Quasi-Experimental Studies (Experimental Studies without random allocation)

Answers: Yes, No, Unclear or Not/Applicable

1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?

Ambiguity with regards to the temporal relationship of variables constitutes a threat to the internal validity of a study exploring causal relationships. The 'cause' (the independent variable, that is, the treatment or intervention of interest) should occur in time before the explored 'effect' (the dependent variable, which is the effect or outcome of interest). Check if it is clear which variable is manipulated as a potential cause. Check if it is clear which variable is measured as the effect of the potential cause. Is it clear that the 'cause' was manipulated before the occurrence of the 'effect'?

2. Were the participants included in any comparisons similar?

The differences between participants included in compared groups constitute a threat to the internal validity of a study exploring causal relationships. If there are differences between participants included in compared groups there is a risk of selection bias. If there are differences between participants included in the compared groups maybe the 'effect' cannot be attributed to the potential 'cause', as maybe it is plausible that the 'effect' may be explained by the differences between participants, that is, by selection bias. Check the characteristics reported for participants. Are the participants from the compared groups similar with regards to the characteristics that may explain the effect even in the absence of the 'cause', for example, age, severity of the disease, stage of the disease, co-existing conditions and so on? [NOTE: In one single group pre-test/post-test studies where the patients are the same (the same one group) in any pre-post comparisons, the answer to this question should be 'yes.']

3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?

In order to attribute the 'effect' to the 'cause' (the exposure or intervention of interest), assuming that there is no selection bias, there should be no other difference between the groups in terms of treatments or care received, other than the manipulated 'cause' (the intervention of interest). If there are other exposures or treatments occurring in the same time with the 'cause', other than the intervention of interest, then potentially the 'effect' cannot be attributed to the intervention of interest, as it is plausible that the 'effect' may be explained by other exposures or treatments, other than the intervention of interest, occurring in the same time with the intervention of interest. Check the reported exposures or interventions received by the compared groups. Are there other exposures or treatments occurring in the same time with the intervention of interest? Is it plausible that the 'effect' may be explained by other exposures or treatments occurring in the same time with the intervention of interest?

4. Was there a control group?

Control groups offer the conditions to explore what would have happened with groups exposed to other different treatments, other than to the potential 'cause' (the intervention of interest). The comparison of the treated group (the group exposed to the examined 'cause', that is, the group receiving the intervention of interest) with such other groups strengthens the examination of the causal plausibility. The validity of

causal inferences is strengthened in studies with at least one independent control group compared to studies without an independent control group. Check if there are independent, separate groups, used as control groups in the study. *[Note: The control group should be an independent, separate control group, not the pre-test group in a single group pre-test post-test design.]*

5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?

In order to show that there is a change in the outcome (the 'effect') as a result of the intervention/treatment (the 'cause') it is necessary to compare the results of measurement before and after the intervention/treatment. If there is no measurement before the treatment and only measurement after the treatment is available it is not known if there is a change after the treatment compared to before the treatment. If multiple measurements are collected before the intervention/treatment is implemented then it is possible to explore the plausibility of alternative explanations other than the proposed 'cause' (the intervention of interest) for the observed 'effect', such as the naturally occurring changes in the absence of the 'cause', and changes of high (or low) scores towards less extreme values even in the absence of the 'cause' (sometimes called regression to the mean). If multiple measurements are collected after the intervention/treatment is implemented it is possible to explore the changes of the 'effect' in time in each group and to compare these changes across the groups. Check if measurements were collected before the intervention of interest was implemented. Were there multiple pre-test measurements? Check if measurements were collected after the intervention of interest was implemented. Were there multiple post-test measurements?

6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?

If there are differences with regards to the loss to follow up between the compared groups these differences represent a threat to the internal validity of a study exploring causal effects as these differences may provide a plausible alternative explanation for the observed 'effect' even in the absence of the 'cause' (the treatment or exposure of interest). Check if there were differences with regards to the loss to follow up between the compared groups. If follow up was incomplete (that is, there is incomplete information on all participants), examine the reported details about the strategies used in order to address incomplete follow up, such as descriptions of loss to follow up (absolute numbers; proportions; reasons for loss to follow up; patterns of loss to follow up) and impact analyses (the analyses of the impact of loss to follow up on results). Was there a description of the incomplete follow up (number of participants and the specific reasons for loss to follow up)? If there are differences between groups with regards to the loss to follow up, was there an analysis of patterns of loss to follow up? If there are differences between the groups with regards to the loss to follow up, was there an analysis of the impact of the loss to follow up on the results?

7. Were the outcomes of participants included in any comparisons measured in the same way?

If the outcome (the 'effect') is not measured in the same way in the compared groups there is a threat to the internal validity of a study exploring a causal relationship as the differences in outcome measurements may be confused with an effect of the treatment or intervention of interest (the 'cause'). Check if the outcomes were measured in the same way. Same instrument or scale used? Same measurement timing? Same measurement procedures and instructions?

8. Were outcomes measured in a reliable way?

Unreliability of outcome measurements is one threat that weakens the validity of inferences about the statistical relationship between the 'cause' and the 'effect' estimated in a study exploring causal effects. Unreliability of outcome measurements is one of different plausible explanations for errors of statistical inference with regards to the existence and the magnitude of the effect determined by the treatment

(‘cause’). Check the details about the reliability of measurement such as the number of raters, training of raters, the intra-rater reliability, and the inter-raters reliability within the study (not to external sources). This question is about the reliability of the measurement performed in the study, it is not about the validity of the measurement instruments/scales used in the study. *[Note: Two other important threats that weaken the validity of inferences about the statistical relationship between the ‘cause’ and the ‘effect’ are low statistical power and the violation of the assumptions of statistical tests. These other threats are not explored within Question 8, these are explored within Question 9.]*

9. Was appropriate statistical analysis used?

Inappropriate statistical analysis may cause errors of statistical inference with regards to the existence and the magnitude of the effect determined by the treatment (‘cause’). Low statistical power and the violation of the assumptions of statistical tests are two important threats that weakens the validity of inferences about the statistical relationship between the ‘cause’ and the ‘effect’. Check the following aspects: if the assumptions of statistical tests were respected; if appropriate statistical power analysis was performed; if appropriate effect sizes were used; if appropriate statistical procedures or methods were used given the number and type of dependent and independent variables, the number of study groups, the nature of the relationship between the groups (independent or dependent groups), and the objectives of statistical analysis (association between variables; prediction; survival analysis etc.).

JBI CRITICAL APPRAISAL CHECKLIST FOR CASE CONTROL STUDIES

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not applicable
1. Were the groups comparable other than the presence of disease in cases or the absence of disease in controls?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were cases and controls matched appropriately?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Were the same criteria used for identification of cases and controls?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Was exposure measured in a standard, valid and reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Was exposure measured in the same way for cases and controls?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Were confounding factors identified?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were strategies to deal with confounding factors stated?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Were outcomes assessed in a standard, valid and reliable way for cases and controls?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Was the exposure period of interest long enough to be meaningful?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Was appropriate statistical analysis used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: Include Exclude Seek further info

Comments (Including reason for exclusion)

EXPLANATION OF CASE CONTROL STUDIES

CRITICAL APPRAISAL

How to cite: Moola S, Munn Z, Tufanaru C, Aromataris E, Sears K, Sfetcu R, Currie M, Qureshi R, Mattis P, Lisy K, Mu P-F. Chapter 7: Systematic reviews of etiology and risk . In: Aromataris E, Munn Z (Editors). *JBIManual for Evidence Synthesis*. JBI, 2020. Available from <https://synthesismanual.jbi.global>

Case Control Studies Critical Appraisal Tool

Answers: Yes, No, Unclear or Not/Applicable

1. Were the groups comparable other than presence of disease in cases or absence of disease in controls?

The control group should be representative of the source population that produced the cases. This is usually done by individual matching; wherein controls are selected for each case on the basis of similarity with respect to certain characteristics other than the exposure of interest. Frequency or group matching is an alternative method. Selection bias may result if the groups are not comparable.

2. Were cases and controls matched appropriately?

As in item 1, the study should include clear definitions of the source population. Sources from which cases and controls were recruited should be carefully looked at. For example, cancer registries may be used to recruit participants in a study examining risk factors for lung cancer, which typify population-based case control studies. Study participants may be selected from the target population, the source population, or from a pool of eligible participants (such as in hospital-based case control studies).

3. Were the same criteria used for identification of cases and controls?

It is useful to determine if patients were included in the study based on either a specified diagnosis or definition. This is more likely to decrease the risk of bias. Characteristics are another useful approach to matching groups, and studies that did not use specified diagnostic methods or definitions should provide evidence on matching by key characteristics. A case should be defined clearly. It is also important that controls must fulfil all the eligibility criteria defined for the cases except for those relating to diagnosis of the disease.

4. Was exposure measured in a standard, valid and reliable way?

The study should clearly describe the method of measurement of exposure. Assessing validity requires that a 'gold standard' is available to which the measure can be compared. The validity of exposure measurement usually relates to whether a current measure is appropriate or whether a measure of past exposure is needed.

Case control studies may investigate many different 'exposures' that may or may not be associated with the condition. In these cases, reviewers should use the main exposure of interest for their review to answer this question when using this tool at the study level.

Reliability refers to the processes included in an epidemiological study to check repeatability of measurements of the exposures. These usually include intra-observer reliability and inter-observer reliability.

5. Was exposure measured in the same way for cases and controls?

As in item 4, the study should clearly describe the method of measurement of exposure. The exposure measures should be clearly defined and described in detail. Assessment of exposure or

risk factors should have been carried out according to same procedures or protocols for both cases and controls.

6. Were confounding factors identified?

Confounding has occurred where the estimated intervention exposure effect is biased by the presence of some difference between the comparison groups (apart from the exposure investigated/of interest). Typical confounders include baseline characteristics, prognostic factors, or concomitant exposures (e.g. smoking). A confounder is a difference between the comparison groups and it influences the direction of the study results. A high quality study at the level of case control design will identify the potential confounders and measure them (where possible). This is difficult for studies where behavioral, attitudinal or lifestyle factors may impact on the results.

7. Were strategies to deal with confounding factors stated?

Strategies to deal with effects of confounding factors may be dealt within the study design or in data analysis. By matching or stratifying sampling of participants, effects of confounding factors can be adjusted for. When dealing with adjustment in data analysis, assess the statistics used in the study. Most will be some form of multivariate regression analysis to account for the confounding factors measured. Look out for a description of statistical methods as regression methods such as logistic regression are usually employed to deal with confounding factors/ variables of interest.

8. Were outcomes assessed in a standard, valid and reliable way for cases and controls?

Read the methods section of the paper. If for e.g. lung cancer is assessed based on existing definitions or diagnostic criteria, then the answer to this question is likely to be yes. If lung cancer is assessed using observer reported, or self-reported scales, the risk of over- or under-reporting is increased, and objectivity is compromised. Importantly, determine if the measurement tools used were validated instruments as this has a significant impact on outcome assessment validity.

Having established the objectivity of the outcome measurement (e.g. lung cancer) instrument, it's important to establish how the measurement was conducted. Were those involved in collecting data trained or educated in the use of the instrument/s? (e.g. radiographers). If there was more than one data collector, were they similar in terms of level of education, clinical or research experience, or level of responsibility in the piece of research being appraised?

9. Was the exposure period of interest long enough to be meaningful?

It is particularly important in a case control study that the exposure time was sufficient enough to show an association between the exposure and the outcome. It may be that the exposure period may be too short or too long to influence the outcome.

10. Was appropriate statistical analysis used?

As with any consideration of statistical analysis, consideration should be given to whether there was a more appropriate alternate statistical method that could have been used. The methods section should be detailed enough for reviewers to identify which analytical techniques were used (in particular, regression or stratification) and how specific confounders were measured.

For studies utilizing regression analysis, it is useful to identify if the study identified which variables were included and how they related to the outcome. If stratification was the analytical approach used, were the strata of analysis defined by the specified variables? Additionally, it is also important to assess the appropriateness of the analytical strategy in terms of the assumptions associated with the approach as differing methods of analysis are based on differing assumptions about the data and how it will respond.