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Breastfeeding in Germany – promotion in maternity hospitals and breastfeeding rates during the first year of life

Dissertation

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Nele Hockamp

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Abbreviations

AWMF	Association of the Scientific Medical Societies in Germany
BBF	Becoming Breastfeeding Friendly
BBFI	BBF Index
BBFI-TS	BBFI Total Score
BEEG	Federal Parental Allowance and Parental Leave Act
BFGM	Breastfeeding Gear Model
BFHI	Baby-Friendly Hospital Initiative
BfR	German Federal Institute for Risk Assessment
BMEL	German Federal Ministry of Food and Agriculture
BPI	Breastfeeding Promotion Index
CODE	International Code of Marketing of Breast-milk Substitutes
DONALD	Dortmund Nutritional and Anthropometric Longitudinally Designed
ESPGHAN	European Society for Paediatric Gastroenterology, Hepatology, and Nutrition
GTS	Gear Total Score
HMOs	Human milk oligosaccharides
IBCLC	International Board Certified Lactation Consultant
IQTIG	Institute for Quality Assurance and Transparency in Healthcare
KiGGS	German Health Interview and Examination Survey for Children and Adolescents
MECs	Mammary epithelial cells
MRI	Max Rubner-Institut
Network	Healthy Start – Young Family Network
NSK	National Breastfeeding Committee
OR	Odds Ratio
pp	Postpartum
RR	Relative Risk
SIDS	Sudden infant death syndrome
SUKIE	Säuglings- und Kinderernährung
SuSe	Study on Breastfeeding and Infant Nutrition in Germany
UNICEF	United Nations International Children‘s Emergency Fund
WHA	World Health Assembly
WHO	World Health Organization
10 Steps	Ten Steps to Successful Breastfeeding
95% CI	95% Confidence Interval

1. Introduction

Becoming a mother is accompanied by numerous physical changes, including those in the breast, preparing to supply the infant with milk after birth [1]. Human breastmilk is a dynamic fluid containing nutrients and other bioactive molecules, which are beneficial for the infant [2]. Infant formula, on the other hand, is standardized with a limited number of ingredients in defined concentration ranges [2]. Several studies have shown that breastfeeding offers multiple benefits to the breastfed infant, the lactating mother, and the society [3,4]. Considering health, nutritional needs, and abilities of infants [5], professional societies in Europe recommend exclusive or full breastfeeding for at least 4 months, followed by age-appropriate complementary feeding introduced no later than the beginning of the 7th month along with partial breastfeeding for as long as mother and infant desire [6,7]. However, certain structural, cultural, and individual factors may hinder mothers from establishing a successful breastfeeding relationship with their child to achieve this recommendation [8,9].

In order to improve breastfeeding practices, numerous international initiatives have been launched [10–12]. In consequence, the National Breastfeeding Committee (NSK; Nationale Stillkommission) was founded in Germany in 1994 and has since been working to improve breastfeeding behavior and practices in Germany [13]. As part of breastfeeding promotion measures, breastfeeding data have to be collected and evaluated at regular intervals within the framework of breastfeeding monitoring, e.g., in order to enable targeted breastfeeding promotion at the national level [14,15]. The “Study on Breastfeeding and Infant Nutrition in Germany” (SuSe; Stillen und Säuglingsernährung in Deutschland), conducted in 1997–1998 (SuSe I) [16–18] and again in 2017–2019 (SuSe II) [19,20] provided important data within this framework.

The aim of this thesis therefore is to provide an in-depth look at the status of breastfeeding promotion in maternity hospitals and breastfeeding rates in Germany at two points in time 20 years apart, based on the two SuSe studies. In addition, the association between breastfeeding promotion in maternity hospitals and maternal breastfeeding success, measured as exclusive breastfeeding during the first 4 months postpartum (pp) is investigated, considering potential determinants of breastfeeding, in order to identify targeted starting points for breastfeeding promotion in Germany.

2. Theoretical Background

2.1 Breastfeeding

Human breastmilk is considered the gold standard for infant feeding [2]. The following sections briefly describe the physiology of lactation, the components of breastmilk, and what benefits breastfeeding may offer to the infant, the mother, and society. In addition, recommendations for breastfeeding are presented and explained, and determinants that may influence breastfeeding success are mentioned.

2.1.1 Stages of Lactation

2.1.1.1 Pregnancy

The onset of pregnancy leads to changes in the mammary gland. Regulated by systemic hormones like progesterone and prolactin, the proliferation of ductal and alveolar cells and the reduction of the fat pad occur, leading to the formation of an extensively branched ductal system with a large number of alveoli [1,21,22]. By the end of the first half of pregnancy, the final structure of the ductal system is established. Small amounts of a secretion product called colostrum, produced and secreted by the mammary epithelial cells (MECs), can be observed in the lumen of alveoli and milk ducts (secretory differentiation of MECs referred to as lactogenesis I) [1]. Towards the end of pregnancy, the proliferation of new alveoli is reduced, while their size further increases due to the accumulation of colostrum in their lumen (terminal differentiation of MECs into lactocytes) [1]. Until parturition, high plasma concentrations of progesterone inhibit the secretion of colostrum [22].

2.1.1.2 Lactation

The expulsion of the placenta after birth results in a reduction of progesterone, human placental lactogen, and estrogen and, together with the presence of high plasma concentrations of prolactin and adequate concentrations of cortisol, triggers secretory activation (lactogenesis II) and subsequently increasing milk secretion [1,23]. Secretory activation usually occurs over the first days after birth and the timing varies individually [2,24].

It is perceived by most mothers as a sudden increase in breast tension as the milk comes in [25]. If the onset of lactogenesis II occurs after 72 hours pp, it is referred to as delayed onset [2,24].

During the first 30–40 hours pp, only very small volumes (~30 ml/24 h) of colostrum are available [26], but the amount of milk produced usually increases rapidly [27], as both, the frequency of breastfeeding and the volume consumed by the newborn increase [1]. The production of colostrum in the first few days after birth is followed by a period of transitional milk secretion (10–15 days), before mature milk is produced (after around 15 days) [1]. After about 1 month, milk volume stabilizes (~750–800 ml/day) [25], and remains relatively constant for the first 6 months pp [27]. For the establishment of breastfeeding, early milk removal, correct attachment of the newborn to the nipple, as well as the efficiency and frequency of suction are of critical importance, especially in the first 3 days pp [1,27].

Milk production is regulated not only by hormones, but also by interactions between the mammary gland and the central nervous system [1,22]. In response to the newborn suckling at the breast or to other stimuli like the sight or sound of the baby, oxytocin is rapidly released from the posterior pituitary [1,22,28]. It triggers milk ejection (milk ejection reflex or let-down reflex) from the nipple by inducing the contraction of myoepithelial cells surrounding the alveoli in the mammary gland. In addition to oxytocin, prolactin is also required for the maintenance of lactation as it stimulates lactose and milk protein synthesis and secretion and ensures the survival of alveolar MECs. Prolactin is produced in the anterior pituitary and released in response to suckling [1,22].

Despite appropriate breastfeeding technique, support, maternal knowledge, and motivation, about 1 in 20 women worldwide experience impaired lactation. Risk factors result in delayed lactogenesis II and/or insufficient lactation [29]. In the case of delayed lactogenesis II, most women are able to achieve full lactation to exclusively breastfeed, but in the case of insufficient lactation, women are unable to attain an adequate milk production [29,30]. Factors associated with a delay in lactogenesis II that are not effectively managed can lead to insufficient lactation [30].

There are preglandular factors causing a disruption in the endocrine system, such as diabetes mellitus, obesity, or thyroid dysfunction; glandular factors, such as the lack of glandular tissue for milk production and storage due to inadequate mammary gland development or breast surgery; and postglandular factors involving the infant, such as cleft lip/palate and ankyloglossia, leading to inadequate breast emptying, or maternal medication interfering with milk production [29]. Women at risk need to be identified early and monitored closely to reach their full breastfeeding potential [29,30].

2.1.1.3 Involution

Weaning begins with the interruption of breastfeeding causing the involution of the mammary gland in a two-step process [31]. At first, milk stasis induces the expression of pro-apoptotic factors such as the *Transforming Growth Factor-ß* which results in MECs detaching from the alveolar structures and being shed into the lumen of the alveoli [31]. At the same time, milk protein production is down-regulated [32]. The integrity of the alveolar structure is maintained during this first phase, because neighboring cells migrate in to fill the gap [31]. If breastfeeding is not resumed within a few days, the second phase of involution begins, which is characterized by the loss of systemic hormonal stimulation (survival factors) and the activation of proteinases (death factors) leading to irreversible tissue remodeling [32]. The extracellular matrix surrounding each alveolus is thereby broken down by matrix metalloproteases, leading to detachment induced apoptosis and alveolar collapse. The re-differentiation of the adipocytes completes the remodeling process and full involution returns the mammary gland to its pre-pregnancy state [31].

2.1.2 Composition of Human Breastmilk

The composition of human breastmilk is dynamic and uniquely suited to the infant [2]. It varies between mothers and changes within feeds, throughout the day and during the course of lactation [2]. Breastmilk is a complex emulsion of aqueous fluid and fat [1] and contains, e.g., more than 900 different proteins, over 200 different human milk oligosaccharides (HMOs), long-chain polyunsaturated fatty acids, a variety of vitamins and minerals, microbiota, and various cellular components [33]. The components derive from different sources: some are from dietary origin, some originate from maternal stores, and some from synthesis in the lactocyte [2].

Due to breastmilk production, exclusively breastfeeding women have an increased energy requirement of around 500 kcal/day during the first 4 to 6 months and the requirement for certain nutrients such as iodine is also increased [34,35]. Since the content of certain nutrients in breastmilk depends on the maternal diet, e.g., in terms of the nutrients docosahexaenoic acid (DHA) and iodine, breastfeeding women should eat a varied and balanced diet (and take dietary supplements if necessary) in order to produce adequate breastmilk [7,35].

Colostrum, the first milk produced, is low in quantity but rich in bioactive factors such as lactoferrin, secretory immunoglobulin A, epidermal growth factor, and HMOs, which protect the newborn against inflammation and infection, contribute to organ development, immune maturation, and healthy microbial colonization [2,33]. Colostrum contains relatively low concentrations of lactose, lower levels of lipids, calcium, folate and potassium, but higher levels of protein, selenium, HMOs, sodium, Vitamin A, C and E, iron, iodine, zinc, magnesium and chloride compared to later breastmilk [2,36]. Secretory activation is associated with a variety of metabolic changes that contribute to these differences in milk composition [27]. Mature milk remains relatively similar in composition, containing ~1.1% proteins, ~7% carbohydrates, ~4% lipids, ~0.2% minerals, and ~87.5% water [37].

Due to its dynamic nature and the presence of hundreds of different bioactive molecules that cannot yet be imitated, breastmilk differs enormously from infant formula, which is standardized with a limited number of ingredients, making human breastmilk the gold standard for infant feeding [2].

2.1.3 Benefits of Breastfeeding

2.1.3.1 Benefits for Children

Unless there are contraindications to breastfeeding, such as classic galactosemia in the infant or a drug addiction in the mother [38,39], being breastfed can provide both, short-term and long-term benefits for the health of almost all children. Several studies have shown that breastfeeding is associated with a lower morbidity and mortality from diarrhea and respiratory infections [3,40]. In addition, breastfeeding may prevent overweight/obesity and type 2 diabetes later in life [3,41].

Besides the potential physical health benefits, breastfeeding has been associated with heightened socio-affective responding and improved cognitive performance [42]. Moreover, compared to formula-fed infants, the greater sensory variability of breast milk may support flavor learning and help breastfed infants to accept healthier foods more readily and to develop healthier, more varied dietary food patterns [43,44].

2.1.3.2 Benefits for Mothers

In addition to the benefits for breastfed children, there are also a number of immediate and long-term effects for nursing mothers. Breastfeeding promotes maternal recovery from pregnancy, improves birth spacing, can prevent breast cancer, and might reduce the risk of diabetes and ovarian cancer [3,45]. Research also indicates that breast-feeding may have psychological effects on mothers. It has the potential to improve maternal care and sensitivity, reduce stress, and facilitate positive emotion [42]. Furthermore, breastfeeding is convenient, eliminating the hygienically challenging and time-consuming preparation of infant formula [46].

2.1.3.3 Benefits for Society

The health benefits of breastfeeding for children and mothers result in benefits for the entire population. Breastfeeding can avoid enormous economic losses, e.g., by saving treatment costs and avoiding income losses due to morbidity and mortality [4]. According to a WHO source, countries lose more than $300 billion per year due to low breastfeeding rates [9,47]. In addition, breastfeeding can also save environmental costs, as breastfeeding has a lower carbon footprint compared to the use of breastmilk substitutes [48]. Even though a breastfeeding woman has additional caloric and nutrient needs compared to a non-breastfeeding woman [34], breastfeeding eliminates the cost of manufacturing breastmilk substitutes, i.e., processing raw materials, trans-portation, packaging, preparation at home, and waste [48].

2.1.4 Recommendations on Breastfeeding

Given the numerous potential benefits of breastfeeding, professional societies in Europe recommend exclusive or full breastfeeding for at least 4 months after birth [6,7] and consider exclusive or predominant breastfeeding for approximately 6 months as a desirable goal [6].

During this time, the majority of infants do not require any liquids or (semi-)solids other than breastmilk [5], but according to the definition of exclusive breastfeeding, additional medicines, vitamins, and minerals may be given as drops or syrup if needed [49]. In order to meet an infant's increasing energy and nutrient needs, infants should thereafter receive age-appropriate and adequate complementary foods along with breastmilk, i.e., should be partially breastfed for as long as mother and infant desire [6,7].

In addition to the nutritional needs of an infant, the timing of introduction of complementary foods depends on the infant's interest in non-milk foods and feeding and developmental abilities [5,6]. The changes required for the transition from a liquid to a (semi-)solid diet are anatomical changes in the oral cavity, the disappearance or diminishing of the extrusion reflex of the tongue, and the development of motor skills such as head and trunk control to enable improved jaw movements [5]. Infants at risk of iron depletion (e.g., exclusively breastfed infants born to mothers with a low iron-status or with a high growth velocity) may benefit from the timely introduction of complementary foods [5]. Due to the interindividual variability in nutritional needs and neuro-motor development, it is not possible to specify a precise age at which all infants should start complementary feeding [5]. In Germany, it is recommended to introduce complementary foods no earlier than the beginning of the 5th month of life and no later than the beginning of the 7th month [7,50]. The European Society for Paediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN) gives the same recommendation and additionally specifies the period of 17–26 weeks in which complementary feeding should be started [6].

On a global basis, the WHO recommends exclusive breastfeeding for the first 6 months of life and continued breastfeeding up to 2 years or beyond [51]. In 2001, the recommendation for exclusive breastfeeding was changed from 4 to 6 months to 6 months taking into account the protection against infectious diseases provided by exclusive breastfeeding, which is particularly important for populations in poor countries [52].

However, many mothers do not achieve this recommendation. The WHO estimates that worldwide between 2015 and 2020 about 44% of infants 0–6 months old were exclusively breastfed [51]. The reasons for this are manifold [8,9].

2.1.5 Determinants of Breastfeeding

To answer the question of why breastfeeding recommendations are often not achieved and how breastfeeding rates can be increased, it is necessary to look at the determinants affecting the initiation and duration of (exclusive) breastfeeding [8]. Breastfeeding behaviors and practices are affected by a variety of cultural, socio-economic, and individual factors that operate at multiple levels and over time [9]. The determinants can have both a positive and a negative impact on breastfeeding and some are modifiable while others are less or not modifiable at all [8,9]. **Figure 1** shows determinants on a structural, social, and individual level known to influence breastfeeding initiation and duration.

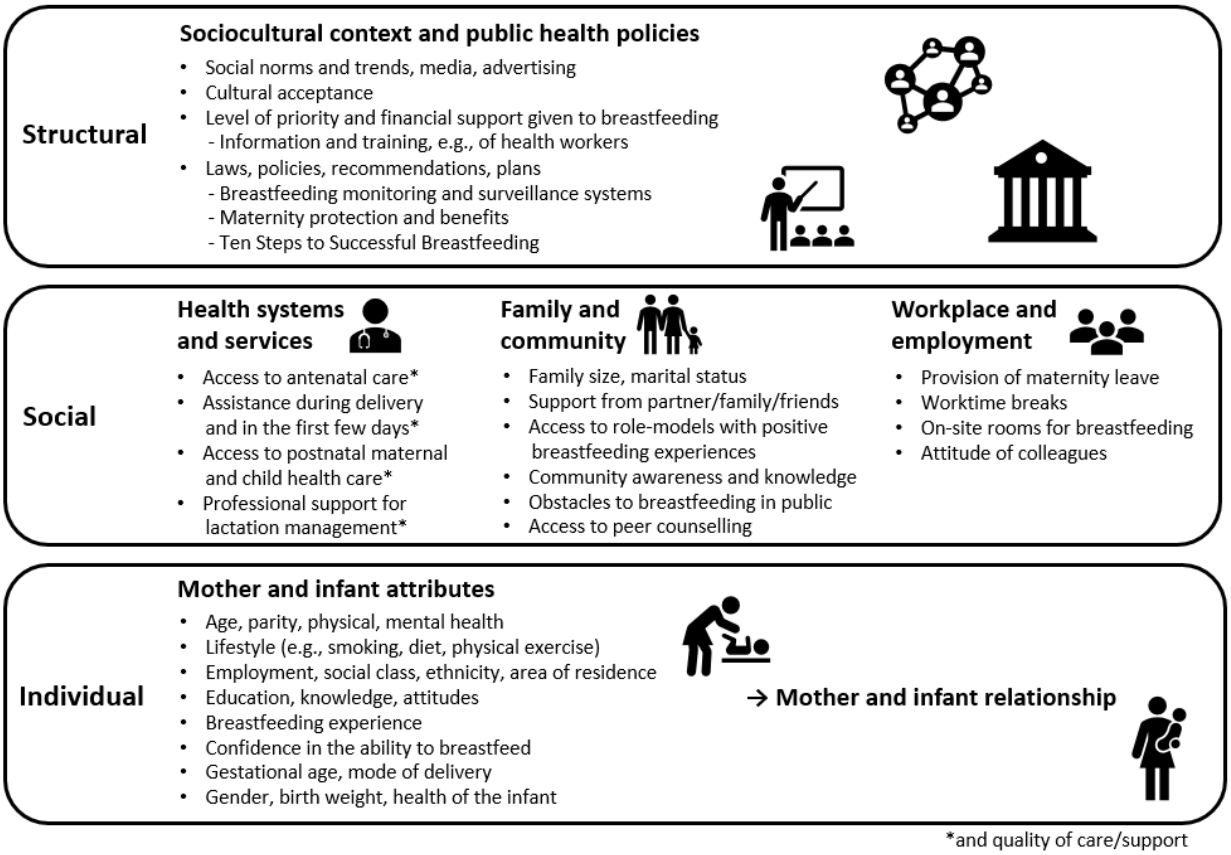

Figure 1 Determinants of Breastfeeding modified according to [8,9,14]

2.1.5.1 Structural Level

The determinants at the structural level (see **Figure 1**) relate to social attitudes of the population towards breastfeeding, which are influenced, e.g., by their level of knowledge, by the portrayal of breastfeeding in the media and social trends, but also by laws and policies that affect breastfeeding, e.g., provision of maternity protection and benefits or investments in the training of health care personnel [8,9,14].

2.1.5.2 Social Level

In their social environment (see **Figure 1**), pregnant women and mothers are exposed to determinants of breastfeeding, whether in the health care system, in the context of the family and immediate community, or in the work environment [9]. For instance, early initiation of breastfeeding, living in a small family, access to a role model with a positive breastfeeding experience, or workplace support and flexibility have a positive impact on breastfeeding, whereas the use of teats and bottle feeding in the maternity ward, a low level of community support, or a short maternity leave have a negative impact [8].

2.1.5.3 Individual Level

At the individual level (see **Figure 1**), e.g., high maternal education and a healthy newborn are positively associated with breastfeeding, while low maternal confidence, no breastfeeding experience with a previous child, and maternal smoking are negatively associated [8]. Determinants at the individual level involving the physical and mental health of a mother are important, because of the large number of women affected [9].

Through the structural level, which affects the entire population in different ways, the various information, interactions, attitudes, and practices help or hinder mothers to establish a successful breastfeeding relationship with their child [9].

2.2 Breastfeeding Promotion

In order to improve the initiation, exclusivity, and duration of breastfeeding throughout the world, numerous international initiatives have been launched. These include, e.g., the “International Code of Marketing of Breast-milk Substitutes” (the Code) [10], the “Ten Steps to Successful Breastfeeding” (10 Steps) [11], the “Innocenti Declaration on the Protection, Promotion and Support of Breastfeeding” (Innocenti Declaration 1990) [12], and the more recent project “Becoming Breastfeeding Friendly” (BBF) [53]. The following sections briefly describe these international initiatives to promote breastfeeding and present breastfeeding promotion activities in Germany.

2.2.1 International Initiatives for the Promotion of Breastfeeding

2.2.1.1 International Code of Marketing of Breast-milk Substitutes

In 1981, the 34th session of the World Health Assembly (WHA) adopted the “International Code of Marketing of Breast-milk Substitutes” as a minimum requirement to protect and promote appropriate infant feeding [10]. The Code provides recommendations to regulate the marketing of breastmilk substitutes, bottles and teats, and aims to stop the aggressive and inappropriate marketing of breastmilk substitutes [10,54]. Recommendations include, e.g., that products within the scope of the Code should not be advertised to the public, that no free samples or gifts should be given to pregnant women, mothers and their families, or health care workers, and that no images or text idealizing artificial feeding should appear on containers or labels [10].

Although there is only one version of the Code, a number of WHA resolutions have been adopted since 1981 that clarify or extend topics covered in the Code [54]. In 2022, the WHO published a report on the status of implementation of the Code and subsequent relevant WHA resolutions. By then, only 32 (16.5%) out of 194 countries (WHO Member States) had taken measures that were substantially aligned with the Code, while 50 countries (25.8%) had taken no measures at all [55]. In Europe and Central Asia, 51 out of 53 countries had adopted legal measures to implement at least some of the provisions of the Code, but only one country, Armenia, had taken measures that were substantially aligned with the Code [56].

The WHO recommends that countries should use the report to, e.g., identify gaps and update their legal measures, if they have not revised their laws or regulations on the marketing of breastmilk substitutes in recent years [55,56]. By 2030, 40% of countries should have substantially aligned their regulations with the Code [57].

2.2.1.2 Ten Steps to Successful Breastfeeding

Since breastfeeding success is not solely the responsibility of the mother, breastfeeding promotion is a collective societal responsibility in which the health care system, including facilities providing maternity and newborn services play a special role, as health care workers exert a strong influence on feeding decisions at crucial time points around childbirth [9,11]. Therefore, WHO and UNICEF developed the program “Ten Steps to Successful Breastfeeding” in 1989 [11]. The program introduced concrete measures to help health care workers effectively support as many mothers as possible to achieve long-term breastfeeding success [11].

The first two steps include critical management procedures [58]. Facilities providing maternity and newborn services should have a written breastfeeding policy that is routinely communicated to all health care staff (Step 1) and train their health care personnel to implement the policy (Step 2) [11]. The other eight steps represent key clinical practices [58]. Facilities should inform women about the benefits and management of breastfeeding already during pregnancy (Step 3), support mothers to initiate breastfeeding within 30 minutes after birth (Step 4), and show mothers how to breastfeed and how to maintain lactation in case of a separation (Step 5) [11]. In order to allow the breastfeeding relationship between mother and infant to develop without interference, infants should not be given any food or drink other than breastmilk unless medically indicated (Step 6), mother and infant should practice 24h rooming-in (Step 7), breastfeeding should be encouraged on demand (Step 8), and no artificial teats or pacifiers should be given to breastfed infants (Step 9) [11]. By establishing breastfeeding support groups and referring mothers to these groups by the time of discharge (Step 10), mothers continue to receive help if questions arise after discharge [11].

After examining the scientific evidence regarding the 10 Steps [59], WHO and UNICEF published an updated guideline in 2018 [58]. Therein, the wording of each step was updated, but the topic remained unchanged. In addition, Step 1 was extended by two further components: full compliance with the Code and internal monitoring. Rather than a complete prohibition of feeding bottles, teats and pacifiers the updated version of Step 9 focuses on counseling mothers on their use, and Step 10 now focuses more on broader discharge coordination for continued support [58].

Ensuring appropriate maternity services by practicing the 10 Steps served as the impetus for developing the “Baby-Friendly Hospital Initiative” (BFHI) [60]. The initiative was launched in 1991–1992 in response to the Innocenti Declaration 1990 [61]. Facilities that achieve the BFHI criteria and have this objectively confirmed by an external evaluation can thus become a "Baby-Friendly Hospital". The adherence to each of the 10 Steps, as well as the compliance with the Code and subsequent WHA resolutions (now included in Step 1) are the minimum global criteria for “Baby-Friendly” designation [58,61].

As of 2017, 25 years after the BFHI was launched, the WHO estimated that 10% of babies worldwide were born in a facility currently designated as “Baby-Friendly”, with Europe having the highest percentage of births in designated facilities at 36% and Southeast-Asia the lowest at 3% [62]. The target is for the majority of births to occur in “Baby-Friendly” facilities in at least 40% of countries by 2030 [57].

2.2.1.3 Innocenti Declaration on the Protection, Promotion and Support of Breastfeeding

Recognizing the numerous potential benefits of breastfeeding, the “Innocenti Declaration on the Protection, Promotion and Support of Breastfeeding” was adopted by government policy makers from more than 30 countries at the WHO and UNICEF policymakers' meeting on "Breastfeeding in the 1990s: A Global Initiative" in Italy in 1990 [12]. The four operational targets of the declaration were for all governments to (1) appoint a national breastfeeding coordinator and establish a multisectoral national breastfeeding committee, (2) ensure that every facility providing maternity services fully practices all 10 Steps, (3) give effect to the principles and aim of the Code in their entirety, and (4) enact legislation protecting the breastfeeding rights of working women and establish means for its enforcement [12,60].

At the end of 2005, the event “Celebrating Innocenti 1990–2005: Achievements, Challenges and Future Imperatives”, was held in Italy to assess the progress made over the past 15 years and to renew and further improve the commitment to breastfeeding and infant and young child feeding [60]. At the event, the "Innocenti Declaration on Infant and Young Child Feeding" (Innocenti Declaration 2005) [63] was adopted to capture the renewed commitments and five additional operational targets, which had been established in 2002 within the Global Strategy for Infant and Young Child Feeding [60,64].

As a result of the international efforts, a “Blueprint for Action for the protection, promotion and support of breastfeeding in Europe" was published in 2004 to serve as a guideline for breastfeeding promotion in European countries [65]. After the Blueprint's usefulness was tested in practice in eight European countries in 2005, the Blueprint was revised and updated in 2008 [14]. In addition to policies, management and financing, which should form the basis of action plans, as well as support of breastfeeding promotion activities through effective planning of information, education and communication, and appropriate training of health professionals, monitoring and research are also important components of the plan [14].

2.2.1.4 Becoming Breastfeeding Friendly

The international research initiative “Becoming Breastfeeding Friendly” was launched to guide countries in systematically analyzing their status of breastfeeding promotion, and thereby, to identify critical quality control points for scaling up breastfeeding programs to sustainably increase breastfeeding rates [66]. The initiative is based on an evidence-based process that includes a toolbox with three complementary components developed between 2015 and 2016 [53,66].

The Breastfeeding Gear Model (BFGM) of the Yale School of Public Health serves as the basis. The BFGM depicts eight different areas of action for breastfeeding promotion that should work in harmony, like clockwork, to improve a country’s breastfeeding-friendly environment, namely: Advocacy; Political Will; Legislation and Policies; Funding and Resources; Training and Program Delivery; Promotion; Research and Evaluation; and Coordination, Goals, and Monitoring [67].

One component of the toolbox is the BBF Index (BBFI), which consists of the eight gears of the BFGM and 54 corresponding benchmarks to measure the scores of each gear (Gear Total Score (GTS)) and to generate an overall score for each country (BBFI Total Score (BBFI-TS)) [53]. The GTS reveals strengths and weaknesses of each gear and provides guidance on which areas of breastfeeding promotion need to be strengthened. A GTS between 0 and 3 can be achieved, and is interpreted from 0 = “Gear not present” to 2.1 to 3 = “Strong Gear Strength”. Since each gear has a different level of importance, weighted GTS have to be calculated first to determine the BBFI-TS. Subsequently, the weighted GTS for all eight gears are added up and divided by 12.3 (the sum of all gear weights). This gives a BBFI-TS between 0 and 3 for “Weak” (0.0 to 1.0) to “Outstanding Scaling Up Environment“ (3.0) and thus the strength of a country’s breastfeeding-friendly environment [53].

So far, the project has been carried out in Myanmar, Samoa, Germany, and Great Britain (England, Scotland, and Wales) and twice in Mexico and Ghana. In all countries, gaps were identified and key recommendations to address the gaps were made [68].

2.2.2 Breastfeeding Promotion in Germany

2.2.2.1 Legal Framework Conditions

In Germany, various laws aim to protect mother and child during pregnancy, after birth, and during the breastfeeding period, and to support the family [69–72]. The Maternity Protection Act, protects pregnant women, e.g., from unjustified dismissal, regulates protection periods before and after childbirth (employment ban usually 6 weeks before (unless willingness to work is expressly declared) and 8–12 weeks after childbirth), secures income during the period in which employment is prohibited, and provides paid time for medical examinations and breastfeeding (in the first 12 months pp at least twice a day for an extra of 30 minutes or once a day for 1 hour) [69]. The law came into force in 1952 [73] and was last amended in 2019 [69].

In addition, according to the Social Code - Book V - Statutory Health Insurance, which came into force in 1989 and was last updated in 2023, insured persons are entitled to medical care and midwife assistance during pregnancy as well as during and after delivery, as specified in § 24d “medical care and midwife assistance” [70].

This also includes pp care up to 12 weeks after birth and beyond, if necessary, as well as information on regional support services for parents and child as part of the medical consultation, if required [70]. During puerperium, midwives are responsible for breast-feeding counseling and promotion, and provide assistance when problems arise [74].

During the period in which a child is cared for at home, the Act on Parental Allowance and Parental Leave (BEEG; Bundeselterngeld- und Elternzeitgesetz) which came into force in 2007, regulates the entitlement of parents to compensation for loss of income [71]. Parental allowance is available in three types (basic parental allowance, parental allowance plus, partnership bonus), which can also be combined. Parents can receive parental allowance alone or together, apply for it at the same time or alternately, and receive it at once or in intervals [75]. In simple terms, basic parental allowance can be obtained until the child reaches the age of 14 months and varies between 300 and 1,800 euros per month, depending on the income before birth (usually 65% of the net income). Parental allowance plus can be obtained until the child reaches 32 months of age, as long as it is claimed by at least one parent in consecutive months of life from the 15th month of life onwards, and ranges between 150 and 900 euros per month, limited to half of what would accrue after calculation of the basic parental allowance [76]. The partnership bonus can be received by parents who share their family and work duties and by single parents [71]. Under certain requirements, employees are entitled to parental leave until a child reaches the age of three. A portion of up to 24 months can be taken between the third birthday and the child's eighth birthday [71]. Before the introduction of the BEEG, parents could apply for child-raising allowance under the Federal Child-Raising Allowance Act, which came into force in 1986 [77].

In order to protect breastfeeding within the framework of the “International Code of Marketing of Breast-milk Substitutes”, directives, laws, and regulations have come into force since its adoption [78–80]. Currently, the Commission Delegated Regulation (EU) 2016/127 of 25 September 2015 supplementing Regulation (EU) No 609/2013 of the European Parliament and of the Council regulates the specific compositional and in-formation requirements for infant formula and follow-on formula and the requirements on information relating to infant and young child feeding [72].

It states, e.g., that infant and follow-on formula must be labelled with a statement to the superiority of breastfeeding and a statement recommending the use only on the advice of independent experts, that the presentation, advertising and labelling shall not discourage breastfeeding, and that no advertising may be carried out at points of sale or by manufacturers through the distribution of samples, etc., to encourage the purchase of these products [72].

2.2.2.2 National Breastfeeding Committee

In 1994, the NSK was established at the Robert Koch Institute by the Federal Ministry of Health, following a decision by the WHA in 1992 to support the 1990 Innocenti Declaration at the national level [13]. The NSK was founded with the aim of ensuring the acceptance of breastfeeding as the normal diet for infants and to support the development of a new breastfeeding culture in Germany for this purpose [81].

The committee consists of representatives of groups professionally involved with breastfeeding mothers and breastfed infants, and organizations whose goal is to promote breastfeeding in Germany [13]. The NSK's responsibilities include, e.g., advising the federal government on policy initiatives to remove barriers to breastfeeding; coordinating the implementation of breastfeeding promotion activities; assisting in the practical implementation of legislation, guidelines, and recommendations; and evaluation and reporting [13].

In April 2019, the NSK moved from the German Federal Institute for Risk Assessment (BfR) in Berlin, where it had been located since 2002, to the Department of Child Nutrition at the Max Rubner-Institut (MRI) in Karlsruhe [82].

Since its foundation in 1994, the NSK has published a great amount of information for the public and professional groups, has been in contact with international organizations, and has followed international recommendations [15,83–88]. In the following, the work of the NSK is presented in excerpts.

Ten Steps to Successful Breastfeeding

In 1998, the NSK and representatives of medical associations and institutions, published recommendations for the promotion of breastfeeding in hospitals, adapted to German conditions, based on the 10 Steps of WHO and UNICEF. These recommendations were updated in 2007 [83].

In contrast to the original 10 Steps of the WHO and UNICEF [11], the German version includes, e.g., in addition to the breastfeeding policy in Step 1, a breastfeeding coordinator, specifies for Step 4 early breastfeeding within the first hour of life (vs. within the first half hour) and, as additional information to Step 10, that mothers should be made aware of statutory midwifery support at discharge, that a contact person should be available in the maternity facility for short-term discussions of breastfeeding problems, and that a breastfeeding outpatient clinic can be established if a breastfeeding coordinator is available. As an additional recommendation, the Code should be followed [83].

According to the Association for the Support of the WHO/UNICEF initiative “Baby-Friendly” (BFHI) e. V., 20% of births in Germany currently (as of 2023) take place in “Baby-Friendly” facilities [89].

Information Material on Breastfeeding

In addition, the NSK published freely available breastfeeding information leaflets that provide information, e.g., on how to prepare for breastfeeding during pregnancy, describe the benefits of breastfeeding for the mother and her infant, and give advice for facilitating the initiation of breastfeeding [85]. The leaflets also include addresses of organizations that are involved in breastfeeding and offer help with breastfeeding problems [85]. They are intended to be inserted in the maternity log ("breastfeeding recommendations for pregnant women") and the child’s medical checkup booklet ("breastfeeding recommendations for infancy"), and have been published over the years in German, Turkish, English, French, Italian, Russian, and Arabic [84–86].

In 2019, the Healthy Start – Young Family Network (Network) was commissioned by the German Federal Ministry of Food and Agriculture (BMEL; Bundesministerium für Ernährung und Landwirtschaft) to develop and implement a communication strategy for breastfeeding promotion as part of the National Strategy for the Promotion of Breastfeeding [90]. As part of this communication strategy, two new information leaflets for pregnant women and mothers have been developed, which the Network has published in 2021 together with the NSK [87].

Breastfeeding Monitoring

Following the publication of the “Blueprint for Action for the protection, promotion and support of breastfeeding in Europe", which includes monitoring as one important

component [14], the NSK presented an integrative monitoring concept for Germany in 2009 [15]. Monitoring as part of the European Action Plan aims to justify and evaluate needs-based breastfeeding promotion measures at the national level and to enable realistic comparisons of breastfeeding data at the international level [14,15]. Breastfeeding monitoring as defined by the NSK is “the systematic assessment of current, comprehensive, and precise data on breastfeeding rates, breastfeeding behavior, and relevant framework conditions at a national and regional level, with the aim of optimal breastfeeding support” [91].

The integrative concept of the NSK includes three survey fields: "total population", "representative samples", and "risk groups" as well as three associated survey instruments: "screening and prevention examinations", "epidemiological studies", and "evaluation and intervention studies" [15]. Relevant prenatal and perinatal data on breastfeeding should be collected across the entire population, e.g., through the maternity passport, obstetric care, or as part of pediatric screening; in representative samples by conducting epidemiological studies such as the “German Health Interview and Examination Survey for Children and Adolescents” (KiGGS) or SuSe; and in groups with special support needs, such as families with low educational attainment or young mothers, through setting-related evaluation and intervention studies in order to reach these target groups for effective breastfeeding promotion [15,91].

Although partial aspects of the concept have been taken up in the various modules described since its publication in 2009, a sustainable anchoring in the structures of the health care system was lacking for many years [91]. As part of the BBF project (2017-2019) and the resulting National Strategy for the Promotion of Breastfeeding (2021), the topic was taken up again and a longer-term concept was presented [90].

2.2.2.3 Becoming Breastfeeding Friendly

In order to obtain a comprehensive and systematic overview of all structures, actors, and measures for breastfeeding promotion in Germany, the BBF project was carried out in Germany between 2017 and 2019 on the initiative of the BMEL [88,92]. In addition to the NSK, the Network and the Yale School of Public Health were involved in its implementation. A commission of experts from science, politics, practice, and the media applied the BBF-concept and derived recommendations to promote breastfeeding in Germany based on the target-actual performance comparison [88,92].

Overall, Germany was classified as moderately breastfeeding-friendly (general score 1.7 out of 3.0) [92]. The areas of “Legislation and Policies” and “Funding and Resources” were evaluated as strong breastfeeding-friendly (= Strong Gear Strength), meaning that Germany has a comprehensive maternity protection legislation; six of the nine provisions of the Code have been incorporated into national legislation and policies; and federal, state and community-based authorities fund individual initiatives and institutions within the framework of maternal and children’s health in addition to the legal provisions. In contrast, great need for improvement was identified in the areas of "Promotion", e.g., due to the lack of an overarching communication strategy, and "Research and Evaluation" regarding the lack of comprehensive monitoring of the implementation of breastfeeding promotion laws, services and policies, as well as insufficient data collection of breastfeeding indicators [92].

In total, eight recommendations were made (A to H), based on the BFGM's eight different areas of action for breastfeeding promotion (**Table 1**) [92,93]. The development of a national strategy to promote breastfeeding in Germany was presented as a general recommendation (A), into which all other BBF recommendations should be incorporated (B to H) [92,93].

2.2.2.4 The National Strategy for the Promotion of Breastfeeding

Following the calls to action of the BBF project, the National Strategy for the Promotion of Breastfeeding was presented by the BMEL in 2021 [90]. A total of 150 experts were involved in its formulation. The BMEL commissioned the MRI’s Department of Child Nutrition to implement the strategy. To improve the framework conditions for breastfeeding in Germany at all levels in the long term, the strategy focuses on seven strategic fields: evidence-based guidelines; basic and advanced training and continued professional development; prevention and healthcare structures; breastfeeding promotion in municipalities; breastfeeding in the workplace; the marketing of breastmilk substitutes; and systematic breastfeeding monitoring. Communication on breastfeeding promotion is closely interlinked with the seven strategic fields as a cross-sectional task. Each strategy field is described within the framework of the strategy and objectives and approaches to achieve the objectives are formulated (**Table 1**) [90].

Table 1 Recommendations of the BBF project and resulting strategic fields of the National Strategy for the Promotion of Breastfeeding in Germany according to [90,92,93]

BBF Recommendations			
A) German national strategy to promote BF	**National Strategy for the Promotion of BF**		
	Strategy Fields	**Objectives**	**Approaches (examples)**
B) Communication strategy to promote BF	Communication on BF promotion	- Communication activities regarding BF promotion are consolidated and enhanced - Social acceptance of BF is increased and a more BF-friendly atmosphere is encouraged - Families receive target-group specific information and support - Multipliers provide assistance to pregnant and BF women - Responsible actors in the social and structural environments of families are sensitized to the importance of BF	- Evidence-based information and materials with practically applicable content tailored to target groups. - Central information portal for all target groups. - Involvement of all relevant interest groups. - Targeted press and media work. - Personalities and celebrities who publicly promote BF. may encourage women from different social milieus to BF. - Low-threshold information on local counseling and support services for families by multipliers. - Groups that have low-threshold access to vulnerable groups receive fundamental knowledge on the importance and practice of BF and how to advice families about support services. - Support of childcare centers and nurseries with information to create a BF-friendly environment for families. - Preparation of guidelines and teaching content for the strategy fields concerned, e.g., guideline “BF-friendly municipality”. - Continuous evaluation of effectiveness and target achievement.
C) Standards for evidence-based BF support and counseling	Evidence-based guidelines	All relevant occupational groups take the same approach to BF in accordance with the latest scientific findings	- Current development of an AWMF S3-guideline on BF duration and interventions (+ development of an easy-to-understand version for (prospective) parents & families). - Revision of other existing medical guidelines such as “Allergy Prevention” or “Diabetes and Pregnancy” containing BF information. - Publication of the new recommendations.

Continued on the next page

Table 1 (Continued)

D) BF education, training and further education	Basic and advanced training and continued professional development	The relevant occupational groups acquire the necessary knowledge on BF and BF promotion as part of their basic and advanced training or continued professional development	- Analyze curricula to identify any need for adjustment and BF-related training needs. - Uniform, evidence-based teaching content (based on AWMF S3-guideline) considering the different needs of the occupations. - Greater focus on teaching BF knowledge to the medical professionals; networking with the research community in the training of midwives; and anchoring of learning content on BF in the nursing sector.
	Prevention and healthcare structures	The prevention and health-care structures in place are oriented towards the actual needs of women and offer favorable conditions for BF promotion and counseling	- Evaluation of existing healthcare structures for BF counseling and assessment of whether women's needs are being met. - Analysis of the causes and development of proposals in case of identification of deficits, going beyond the midwife-financed system. - Application of the 10 Steps in all maternity and newborn facilities.
E) Local BF support	BF promotion by municipalities	Municipalities support families by providing them with needs-based, interconnected and low-threshold services in the field of BF promotion	- Municipalities should tackle BF promotion, irrespective of the responsibilities of the statutory health insurance; BF promotion should be an integral part of preventive healthcare activities; integration into municipal health planning and reporting schemes. - Establishment as a “BF-friendly municipality” to improve the general conditions for BF and promote the acceptance of BF. - Point vulnerable groups and families with lower socio-economic opportunities to low-threshold BF promotion options. - Support by providing quality-approved information.
F) BF and work	BF in the workplace	The educational and working environment becomes more BF-friendly	- Encourage workplaces to implement measures for BF promotion. - Tailored information on relevant rights, opportunities, and duties. - Best practice examples (“BF fellowships”). - Examination of possible need for action to improve conditions for particular groups, e.g., students and self-employed workers. - Network development to make relevant expertise more widely available and to facilitate an implementation process.

Continued on the next page

Table 1 (Continued)

G) Marketing of human milk substitutes	Marketing of BMS	The regulations on the marketing of BMS are brought more systematically to the attention of experts and authorities to limit the impact of industrial corporations	- Information on the requirements for the marketing of BMS in an easy-to-understand way. - Examination of the need for further regulation. - Raise awareness of responsibility of the German federal states. - Examination of whether the establishment of a central reporting office would facilitate the reporting of violations. - Raise awareness of the risks of lobbying by industrial actors and of the conflicts of interest this might cause.
H) Systematic monitoring of BF	Systematic BF monitoring	A systematic BF monitoring system continuously supplies accurate data on BF behavior in Germany	- New field of research at the Department of Child Nutrition, MRI. - Collection of comprehensive and up-to-date data focusing on mandatory quality assurance procedures in maternal and neonatal medicine, and the regular health screenings for children. - Consideration of data from existing studies. - Concept for the storage and evaluation of the collected data. - Publication of the data at regular intervals.

AWMF, Association of the Scientific Medical Societies in Germany; BBF, Becoming Breastfeeding Friendly; BF, breastfeeding; BMS, breastmilk substitutes; MRI, Max Rubner-Institut; S3 guideline, guideline with the highest quality classification standard

2.3 Studies on Breastfeeding Rates and Duration

In the context of breastfeeding monitoring, well-designed studies are a necessary tool to obtain data on breastfeeding behavior and to enable problem-oriented breastfeeding promotion [91]. As mentioned above, there is a great need for improvement in breastfeeding monitoring in Germany according to Sievers et al. [91] and the results from the BBF project [92].

In addition to the proposed expansion of the use of representative studies like KiGGS or the inclusion of breastfeeding quality indicators in the quality assurance procedure for obstetrics of the Institute for Quality Assurance and Transparency in Healthcare (IQTIG), prospective studies are needed [93]. Such studies allow standardized monitoring of relevant breastfeeding indicators covering pregnancy, the perinatal period, and infancy until at least the end of the first year of life. They should be conducted at regular intervals (e.g., every 5 years). Prospective studies have the advantage over retrospective studies that they can provide more timely, reliable, and comprehensive information on breastfeeding rates and duration, on the promotion of breastfeeding in the hospital setting, and on factors beyond the hospital that influence breastfeeding duration and feeding practices [93].

In Germany, several prospective studies have been conducted collecting breastfeeding data. However, these were mostly limited to certain cities or regions and/or covered only the first months after birth [94].

The two SuSe studies were the only prospective studies that collected nationwide data on maternal breastfeeding experiences in the hospital and on infant feeding in the first year of life. The studies also included a cross-sectional survey of the maternity hospitals in which the mothers had given birth, in order to obtain information about the hospitals' breastfeeding management [16,19]. The SuSe study was first conducted in 1997–1998 (SuSe I) [16–18] and repeated 20 years later (2017–2019) as SuSe II [19,20]. The studies were carried out by the former Research Institute of Child Nutrition in Dortmund (SuSe I) and the successor Research Department of Child Nutrition in Bochum (SuSe II), funded by the German Federal Ministry of Health (SuSe I) and the BMEL (SuSe II) and carried out on behalf of the German Nutrition Society (Deutsche Gesellschaft für Ernährung e. V.) [16,17,19,20].

These two studies form the basis of this dissertation. In the following, the objectives and research questions are outlined and the original articles are presented, followed by a discussion of the findings against the background of current efforts in breast-feeding promotion.

3. Objectives and Research Questions

For many years, efforts have been made to promote breastfeeding worldwide, also in Germany.

Objective I: To provide an in-depth look at the status of breastfeeding promotion in maternity hospitals and breastfeeding rates in Germany at two time points, 20 years apart.

Research Questions
Has breastfeeding promotion in German maternity hospitals improved over a period of 20 years? Do mothers currently better adhere to the recommendations on breastfeeding duration and introduction of complementary feeding than mothers 20 years ago?
Research Approach
A cross-sectional survey on breastfeeding promotion in maternity hospitals and a subsequent prospective survey of breastfeeding and infant nutrition during the first year of life (0.5, 2, 4, 6 and 12 months after birth) in mother-infant pairs who were recruited in the participating hospitals was conducted in the studies on 'breastfeeding and infant nutrition in Germany' named 'SuSe'. Two surveys were conducted using a similar design: SuSe I in 1997–1998 and SuSe II in 2017–2019. In SuSe I, 177 hospitals and 1,717 mother-infant pairs and in SuSe II 109 hospitals and 962 mother-infant pairs were included [16,17,19,20]. Breastfeeding promotion and prevalence were evaluated using recommendations and definitions from WHO and UNICEF [11,49,58].

Objective II: To investigate the association between breastfeeding promotion in maternity hospitals and maternal breastfeeding success, measured as exclusive breastfeeding at 5 time points during the first 4 months of life, considering potential determinants of breastfeeding.

Research Questions

Can the suggested associations in the literature between perinatal breastfeeding promotion in maternity hospitals and maternal breastfeeding duration be verified in Germany? What other determinants of maternal breastfeeding success can be identified?

Research Approach

A secondary data analysis of the nationwide German SuSe II study was conducted. In 103 maternity hospitals, 962 mother-infant pairs were recruited. For further analyses, all mother-infant pairs with complete data at the considered time points were included: at hospital: n = 909, at discharge: n = 915, 2 weeks pp: n = 916, 2 months pp: n = 860, 4 months pp: n = 841. Breastfeeding promotion in hospitals was assessed using the "10 Steps to Successful Breastfeeding" of WHO and UNICEF [11,58], adapted for Germany by the NSK [83]. On the basis of these recommendations a Breastfeeding Promotion Index (BPI) was formed consisting of 10 items that covered the areas of the recommendations and were equally weighted. Each item scored 1 for practising and 0 for not practising the particular step. An index between 0 to 10 for breastfeeding promotion was achievable. Using the percentiles P_{25}, P_{50} and P_{75} as cut-off points, the index was stratified into low (≤ 5), medium (6–8) and high (≥ 9). To assess breastfeeding success at 5 time points, mothers were divided in two groups: mothers exclusively breastfeeding and mothers not exclusively breastfeeding. Exclusive breastfeeding was defined according to the definition given by WHO and UNICEF [49]. The choice of breastfeeding determinants was based on literature [8,95], results from SuSe I [18] and a basic evaluation of SuSe II [19,20].

A detailed description of the methods, the presentation of the results as well as the discussions of the findings can be found in the following two original articles.

4. Original Articles

4.1 Original Article 1: Breast-feeding promotion in hospitals and prospective breast-feeding rates during the first year of life in two national surveys 1997–98 and 2017–19 in Germany [96]

Hockamp N, Burak C, Sievers E, Rudloff S, Burmann A, Thinnes M, Zahn J, Lücke T, Kersting M (2021) Breast-feeding promotion in hospitals and prospective breast-feeding rates during the first year of life in two national surveys 1997–98 and 2017–19 in Germany. *Public Health Nutrition*, 24(9):2411–2423 (Impact Factor: 3.2) .
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Author Contributions: NH conducted data analysis and drafted the manuscript; CB was responsible for survey management in SuSe II; ES gave advice on items covered by the questionnaire, data analysis and interpretation; SR gave advice on human milk research; AB developed and applied the web-based assessment tool; MT and JZ assisted in participant recruitment and data preparation; TL supervised SuSe II; MK conceived and supervised both SuSe studies. All authors critically reviewed the manuscript as submitted.

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Breast-feeding promotion in hospitals and prospective breast-feeding rates during the first year of life in two national surveys 1997–1998 and 2017–2019 in Germany

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Abstract

Objectives: The present study aimed to assess the current state of breast-feeding promotion in hospitals and the prevalence of breast-feeding during the first year of life in Germany and to compare the results with a study 20 years earlier.
Design: In the studies on 'breast-feeding and infant nutrition in Germany' named 'SuSe', a cross-sectional survey in hospitals was combined with a subsequent prospective survey of breast-feeding and infant nutrition during the first year of life (0·5, 2, 4, 6 and 12 months after birth) in mother–infant pairs who were recruited in the hospitals. Written questionnaires and phone calls were used in SuSe I and web-based questionnaires in SuSe II. Breast-feeding promotion and prevalence were evaluated using recommendations from the WHO and the UNICEF.
Setting: Two nationwide surveys SuSe I (1997–1998) and SuSe II (2017–2019).
Participants: In SuSe I, 177 hospitals and 1717 mother–infant pairs and in SuSe II 109 hospitals and 962 mother–infant pairs were included.
Results: In SuSe II, hospitals implemented seven of the WHO 'Ten Steps to Successful Breastfeeding' to a greater extent than the hospitals in SuSe I. More mothers exclusively breastfed for 4 months (57 % *v.* 33 %) and continued breast-feeding until 6 (78 % *v.* 48 %) and 12 months (41 % *v.* 13 %). In both studies, exclusive breast-feeding decreased between 4 and 6 months of age due to the introduction of complementary feeding.
Conclusions: In Germany, breast-feeding habits have come closer to the recommendations over the last 20 years.

Keywords
Breast-feeding assessment
Maternity hospitals
Exclusive breast-feeding
Breast-feeding indicators
WHO Ten Steps

Breast-feeding is the optimal nutrition for infants and is recommended as an exclusive diet for the first months with subsequent partial breast-feeding along with age-appropriate complementary food[1–3].

Advantages of breast-feeding are manifold for infants, mothers and the society. Being breastfed protects against infant mortality and morbidity from infectious diseases such as diarrhoea and pneumonia[4] and may decrease the risk for overweight and diabetes later in life[5,6]. Breast-feeding also decreases the mother's risk of developing breast and ovarian cancer[5,7].

Breast-feeding offers economic and environmental benefits to society through reduced costs of preventable diseases[8,9] and a lower carbon footprint compared to breastmilk substitutes[10]. Breast-feeding is convenient and cost-efficient.

Thus, protection, promotion and support of breast-feeding is an impetus worldwide[2,11,12]. To get breast-feeding started successfully, WHO and UNICEF initiated the programme of the 'Ten Steps to Successful Breast-feeding' in 1989[13,14]. The Baby-friendly Hospital Initiative (BFHI) is based on the adherence to the Ten Steps and has been shown to be effective at improving breast-feeding outcomes globally[15]. To measure breast-feeding

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promotion and support on infant feeding practices within and among countries, indicators were suggested referring to initiation, exclusivity and duration of breast-feeding[16,17]. Based on these international recommendations, the German National Breastfeeding Committee (NSK) developed recommendations for breast-feeding promotion in hospitals in 1998[18] as well as definitions of breast-feeding status adapted to conditions in Germany in 1999[19], both updated in 2007[18,19].

A European action plan, presented in 2004 and updated in 2008, called for standardised breast-feeding monitoring, defined as the systematic assessment of current, comprehensive and precise data on breast-feeding rates and behaviour at a national and regional level[20]. Subsequently, in Germany, the NSK presented an integrative concept of breast-feeding monitoring comprising different levels of structured assessments of breast-feeding as a basis for quality assurance of promoting activities for breast-feeding[21,22].

To systematically collect data on breast-feeding promotion in hospitals providing maternity services and on subsequent breast-feeding rates, two nationwide surveys named 'SuSe' (an abbreviation for 'Stillen und Säuglingsernährung in Deutschland' to be translated as breast-feeding and infant nutrition in Germany) were conducted in Germany 20 years apart with SuSe I 1997–1998[23,24] and SuSe II 2017–2019[25]. The specific study design was essentially maintained and WHO/UNICEF and NSK definitions were applied in both surveys, allowing comparisons of study results.

The objective of this work is therefore to provide an insight into the development of breast-feeding in Germany over a period of 20 years.

Methods

Study structures

The SuSe study design is a combination of a cross-sectional survey on breast-feeding promotion and support in hospitals providing maternity services and a subsequent prospective survey of breast-feeding and infant nutrition during the first year of life in mother–infant pairs who were recruited in the participating hospitals. In SuSe I (1997–1998) and SuSe II (2017–2019), a similar design has been applied. The methodological approach and assessment details were retained as far as possible. However, some modifications had to be made in SuSe II.

The basic population in both studies was the total number of hospitals providing maternity services in Germany, hereinafter referred to as hospitals. The basic population from which the mother–infant samples were drawn were mothers who delivered in the participating hospitals during a pre-defined 2-week period. The mother–infant samples were prospectively followed up from birth for the first year of life with five (SuSe II) or six (SuSe I) assessments on breast-feeding and infant nutrition during the first year of life.

The change in communication modes particularly in the young parent population between the two studies suggested a switch from paper and pencil postal questionnaires and phone calls in SuSe I to web-based questionnaires in SuSe II. The web-based assessment tool was developed and applied by the Fraunhofer Institute for Software and Systems Engineering ISST, Dortmund.

SuSe I was carried out at the former Research Institute of Child Nutrition in Dortmund (Germany), SuSe II at the successor institution, the Research Department of Child Nutrition of the Pediatric Clinic at the University of Bochum (Germany). Obligatory for participation in both studies was the written informed consent of hospitals and mothers.

Recruitment

Hospitals

In SuSe I, a random sample of 360 hospitals was invited from the total of German hospitals (n 1120) in a randomised sequence, while all hospitals (n 712) were invited in SuSe II. In both studies, the chief physicians were invited by postal letter. In case of missing feedback, hospitals were reminded with phone calls (SuSe I + II) and additionally by fax and a video invitation from the study head (SuSe II).

In both studies, the ward staff filled out a 'hospital' questionnaire about their breast-feeding promotion and support practices and supported the recruitment of mothers for the follow-up survey. The chief physicians were requested to name a responsible person at the maternity ward as contact person for the study team. Within a 3-month window (SuSe I: March–May 1997, SuSe II: January–March 2018), each participating hospital was allocated to a pre-specified 2-week period for recruitment of mothers and parallel questionnaire completion.

As a recognition of their participation, hospitals in SuSe I received brochures on breast-feeding and infant nutrition published by the Research Institute of Child Nutrition. In SuSe II, they were offered an in-house training on infant feeding or on pregnancy lifestyle provided by the German 'Healthy Start – Young Family Network' at the Federal Centre for Nutrition (BZfE)[26].

Mother–infant pairs

During the recruitment period, the hospital ward staff was requested to document selected basic information of all births consecutively with documentation forms (SuSe I: n 4352; SuSe II: n 3810). Inclusion criteria were a healthy, full-term newborn (birth weight ≥ 2500 g, gestational age ≥ 37 weeks, no admittance to a neonatal intensive care unit) and sufficient maternal knowledge of the German language as assessed by the staff, the existence of a telephone (SuSe I) and internet access as well as an email address (SuSe II). Written study information including a consent form was handed out to mothers meeting the inclusion criteria on the ward (SuSe I: n 3294; SuSe II: n 2831). Written consents were collected

by the staff and sent to the study team or sent by the mothers after they left the hospital (SuSe I: *n* 1851; SuSe II: *n* 1168). As a reward for their participation, mothers in SuSe I received a brochure with recommendations for child nutrition. They were not informed about this reward in advance but received the information with a letter of thanks upon receipt of the last questionnaire 12 months postpartum (pp). Mothers in SuSe II received health messages via email during the first year of life, a financial compensation of 30 euros and a brochure with recommendations for child nutrition at the end of the survey. Mothers in SuSe II were informed at the time of recruitment about these rewards to appeal in particular to mothers difficult to motivate for participation in trials.

Data collection

Questionnaires

The hospital questionnaire mainly inquired about breast-feeding support practices based on the WHO and UNICEF Ten Step programme, modified for Germany[13,14,18]. The steps were not directly named in the questions, for example, 'Do you have policies for breast-feeding promotion on the ward?' (answer options: yes/no), 'In what form do the policies on breast-feeding promotion exist?' (answer options: written policies/verbal agreements). For several steps, specifications were modified in SuSe II to increase the actual relevance of the answers (see results). In addition, characteristics of the hospital, for example, numbers of births in the last year, certified as 'baby-friendly' by the WHO/UNICEF BFHI were collected from hospitals.

The survey tools for hospitals (hospital questionnaire, documentation form) were tested in both studies in a pilot study in large local hospitals.

During the follow-up survey in both studies, mothers were asked at the infant's age of 2 weeks and 2, 4, 6 and 12 months and in addition at the age of 9 months in SuSe I. In SuSe I, the 2-week assessment was carried out by phone 12 to 16 d pp and the following five assessments by 1-page postal dietary records with a deadline of 2 weeks (± 2 to 4 d). In SuSe II, assessments were web-based, that is, questionnaires were sent by email. Within the first 2 weeks, an additional phone call was planned to motivate the mothers to participate; about 200 mothers were reached by phone. The mothers had a time frame of 4 weeks to answer the first four questionnaires (2 weeks, and 2, 4 and 6 months). In both studies, the 2-week questionnaire assessed the infant feeding practices retrospectively during hospital stay and at discharge and the infant's diet at present. Additionally, maternal characteristics were assessed at this point. The four follow-up questionnaires on current infant nutrition after the age of 2 weeks were the same until the age of 12 months. For answering the last questionnaire, a general deadline was set 3 weeks after the last questionnaire was sent. A more detailed assessment of infant feeding except breast-feeding was possible with the web-based version of the SuSe II tool. In case, the breast-feeding status had changed since the previous questionnaire by adding other fluids or food, mothers were asked in a separate short 'weaning' questionnaire about their reasons for additional feeding other than breast-feeding and about the total duration of exclusive and total breast-feeding. The dietary reporting referred to the current nutrition, for example, 'How many breastmilk feedings does your child receive?' (answer options: during the day/night: none, 1, 2, 3, 4 or more), 'Does your child receive additional liquids (juice, water, tea, other)?' (answer options: yes/no).

The maternal questionnaires were tested in local pilot studies with mothers recruited in a paediatric practice in SuSe I and in hospitals in SuSe II. In SuSe I, each incoming questionnaire was checked for completeness, and implausible or missing information was clarified by telephone inquiries. In SuSe II, the pilot study focused on testing the functioning of the online tool, since the comprehensibility of the questions had already been tested in SuSe I.

Assessment of breast-feeding

For the dietary questions, mostly pre-specified answers had to be selected. Initially, mothers reported the number of meals at daytime and nighttime for breastmilk, allowing for defining breast-feeding 'yes' or 'no'. Subsequently, other milk feedings (e.g. formula and cow's milk), non-milk fluids (e.g. water, tea, and juice) and other liquids (e.g. plant drinks) or (semi-)solids (complementary feeding, 'Beikost') given to the infant had to be indicated. These specifications allowed to define the infant feeding category according to the definitions given by WHO[16,17] and for Germany[19] (Table 1).

Data presentation

Data analysis was performed using the IBM® SPSS® Statistics Version 25.0 software package for Windows 2016 (IBM Corp.). Percentages for categorical variables or frequencies for continuous variables were used for data description. To determine differences between characteristics of participants, the exact test according to Fisher for categorical data and the Mann–Whitney *U* test for non-normally distributed continuous data were used. *P*-values <0·05 (two-sided) were considered to be significant. Continuous data were tested for normal distribution using the Kolmogorov–Smirnov test.

Results

Recruitment of hospitals and mother–infant pairs

An overview of the recruitment and the samples of hospitals and mothers in both studies is shown in Fig. 1. In 2017 (SuSe II), not only was the number of hospitals in Germany smaller, but also the participation rate of the hospitals was lower than in 1997 (SuSe I) (15·8 % *v.* 51·3 %) and less deliveries were recorded during the recruitment periods. In both studies, about half of the reasons for exclusion concerning the infant (birth weight < 2500 g, gestational age < 37 weeks and admittance to a newborn intensive care unit)

Table 1 Definitions of infant feeding categories given by WHO[16,17] and Germany (G)[19] applied in the SuSe studies

Term		Definition
Exclusive breast-feeding	WHO,G	No liquids or solids other than breastmilk/human milk (except medicine/vitamin/mineral drops or syrups)
Predominant breast-feeding	WHO,G	Exclusive breast-feeding including the administration of water and water-based drinks*
Full breast-feeding	WHO,G	Exclusive and predominant breast-feeding
'Zwiemilch'	G	Breastmilk and formula (and/or other non-human milk)
Complementary/partial breast-feeding	WHO, G	Breastmilk and any (semi-)solid food and/or liquid including formula and/or other non-human milk
Any breast-feeding	WHO,G	Any breastmilk
No breast-feeding	G	Non-human milk/formula and/or 'Beikost'†

*Including fruit juice and tea.
†Including all foods and fluids other than breastmilk and formula.

and the other half concerned the mother (no sufficient knowledge of the German language, no telephone (SuSe I + II), no internet access and no email address (SuSe II)). In SuSe I, 1·7 % of mother–infant pairs could not be enrolled in the study due to a delayed arrival of their consent forms at the study centre. The participation rate of the mothers was lower in SuSe II compared to SuSe I (34·0 % *v.* 52·1 %), but in both studies, about 90 % of participating mothers attended the follow-up until the last survey 12 months pp.

Hospitals

Hospital characteristics

The majority of hospitals in SuSe II were academic, while most hospitals in SuSe I were operated by public institutions (Table 2). The mean number of births per hospital per year and the percentage of caesarean sections were almost twice as high in SuSe II compared to SuSe I. In both studies, a similar number of maternity beds were available on the ward, but the average hospital stay was 2 d shorter in SuSe II. The number of hospitals certified as 'baby-friendly' and the availability of lactation consultants on the wards increased considerably over the last 20 years, while the availability of midwives was similar in both studies. In comparison with the respective reference group of all German hospitals, both study samples did not differ with regard to the annual birth rate[27,28] and regional distribution between the former politically separated parts of Eastern and Western Germany.

Breast-feeding promotion and support in hospitals

The recommendations of the Ten Steps were implemented to a varying extent by the hospitals in both studies (Table 3), ranging between 9·7 and 96·0 % of hospitals in SuSe I and 47·7 and 98·2 % in SuSe II. In SuSe II, more than 90 % of the hospitals gave mothers breast-feeding instructions and documented them (Step 5), stated that most mothers practised 24-h rooming-in (Step 7) and encouraged breast-feeding on demand or at least 8–10 times within 24 h without a fixed schedule (Step 8). Hospitals in SuSe II implemented seven steps to a greater extent than hospitals in SuSe I. Great improvements in the last 20 years were mainly observed in structural characteristics such as Step 1 (written breast-feeding policy (and breast-feeding coordinator)), Step 2 (regular training of health care staff), Step 5 (breast-feeding instruction and documentation) and Step 9 (alternative feeding methods). There was a deterioration compared to SuSe I in Step 3 (breast-feeding information) and Step 4 (first initiation of breast-feeding). Step 10 (breast-feeding support group) remained at a similar level. The response options for Step 1 and 8 were updated to the recent German recommendations. For Step 1, in addition to the written breast-feeding policies in SuSe I, a breast-feeding coordinator on the ward had to be present in SuSe II. For Step 8 (breast-feeding on demand), additional options (at least 8/10 times per 24 h without a fixed schedule) were provided. For Steps 3 and 7, hospitals in SuSe II had a single answer option in contrast to multiple choices in SuSe I. Initiation of breast-feeding (Step 4) was asked separately by type of delivery in SuSe II and uniform in SuSe I. Hospitals in SuSe II received a positive rating only if they enabled initiation within the first hour of life for both types of deliveries.

Mother–infant pairs

Characteristics

Characteristics of participating mother–infant pairs of both studies are presented in Table 4. Mothers in the recent study were on average older and better educated than mothers in the previous study. With regard to the mode of delivery, the rate of caesarean section approximately doubled; the average length of hospital stay, however, was about 2 d shorter. There were no differences in the infant characteristics gender and birth weight. Compared to mothers eligible to participate, actual participating mothers in both studies were older, had a higher school education and were more often German citizens. Compared to national statistics, study participants (SuSe II) were older (35–39 years: 29·1 % *v.* 20·2 %) and better educated (higher secondary education: 65·5 % *v.* 43·5 %), and their postnatal stay in the hospital was longer (3–6 d: 81·5 % *v.* 67·6 %), but the rate of caesarean section was higher (31·3 % *v.* 24·7 %)[29,30].

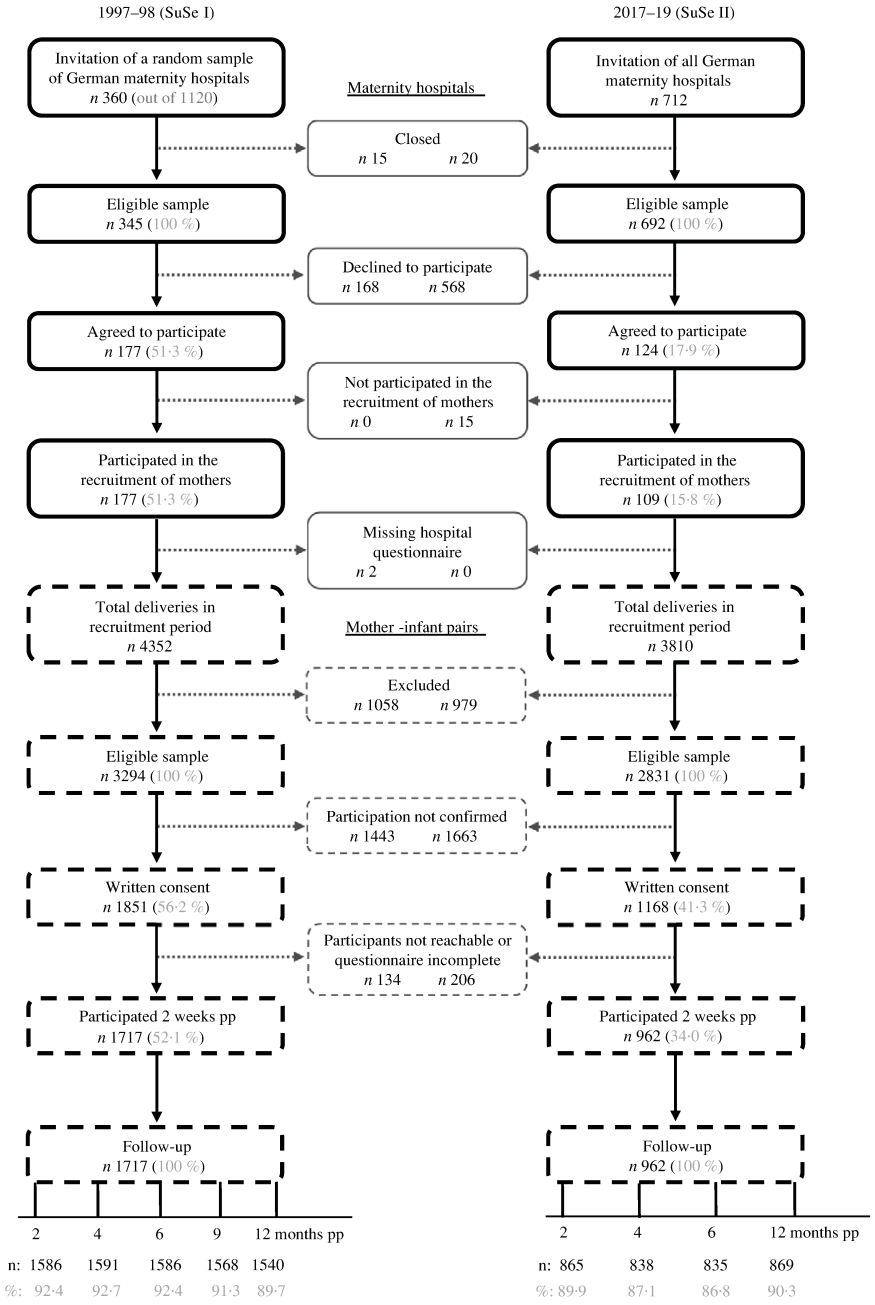

Fig. 1 Flowchart of recruitment and participation in 1997–1998 (SuSe I) and 2017–2019 (SuSe II); pp, postpartum

Breast-feeding prevalence

In SuSe II, 96·6 % of mothers tried to breastfeed after birth, while 90·8 % of mothers tried in SuSe I (data not shown). The rates for exclusive breast-feeding at discharge were similar in both study samples, but thereafter higher in SuSe II than in SuSe I until 6 months pp (Table 5). In the second half of the first year of life, more mothers continued breast-feeding in the recent study with 78 % (41 %) for any breast-feeding at 6 (12) months pp compared to 48 % (13 %) in the previous study. Predominant breast-feeding (breastmilk plus water, tea or fruit juice) played a subordinate role in SuSe II, but breast-feeding plus non-human milk ('Zwiemilch') was practised more frequently. With the introduction of complementary foods after the end of the fourth month pp, exclusive or

Table 2 Hospital characteristics in 1997–1998 (SuSe I) and 2017–2019 (SuSe II)

	1997–1998 SuSe I	2017–2019 SuSe II	
Hospital characteristics	*n* 175†	*n* 109†	*P*-value*
Hospital category (%)‡			
Public	44·0	34·9	0·137
Confessional	38·3	16·5	<0·001
Academic	20·6	62·4	<0·001
Private	n.a.	19·3	1
Births per year (no.)§,‖	579·0 400·0–826·5	978·0 624·5–1520·5	<0·001
Birth categories per year (%)§			<0·001
≤ 500	41·8	14·7	
501–1000	44·1	36·7	
> 1000	14·1	48·6	
Deliveries per assessment period (no.)‖	21·0 14·0–32·3	29·0 14·0–50·0	0·003
Maternity beds (no.)‖	18·0 13·0–24·0	20·0 15·0–26·0	0·035
Caesarean section (%)§,‖	15·0 13·0–19·1	30·0 25·0–34·0	<0·001
Hospital stay (days)§,‖	5·3 5·0–6·0	3·0 3·0–4·0	<0·001
Availability on the ward (%)			
Midwives	75·9	75·2	1
Lactation consultants	15·1	91·7	<0·001
Certified as baby-friendly (%)	1·3	25·7	<0·001

n.a., not asked.
*Fisher's exact test for categorical variables, Mann–Whitney *U* test for non-normally distributed continuous variables; *P* values <0·05 were considered to be significant.
†SuSe I: *n* 177 for births/birth categories per year; *n* 174 for deliveries per assessment period; *n* 171 for number of maternity beds; *n* 170 for days of hospital stay; *n* 166 for caesarean section; *n* 174 (172) for the availability of midwives (lactation consultant) on the ward; SuSe II: *n* 107 for deliveries per assessment period.
‡Multiple answers possible.
§In 1996 for SuSe I; in 2016 for SuSe II.
‖Median and 25th–75th interquartile range.

full breast-feeding was replaced by partial breast-feeding in both studies. The rate of mothers who did not breastfeed was about half as high during the first year of life in SuSe II compared to SuSe I.

Discussion

The two breast-feeding studies, SuSe I and SuSe II, point to an improvement in breast-feeding in Germany over the last 20 years. Since the participation rates of hospitals and mothers were lower in SuSe II compared to SuSe I, it is not possible to distinguish between the potential roles of sample selection or breast-feeding promotion activities for the overall favourable development.

Study design

SuSe I was the first nationwide survey collecting data on breast-feeding promotion in hospitals and prospectively assessing breast-feeding and infant nutrition in the first year of life in Germany. The repetition using a similar study design 20 years later provided an insight into the development of breast-feeding over time. By starting data collection at birth, the breast-feeding continuum from hospital care to family practice was covered. Combined with data on maternal characteristics and attitudes, determinants of breast-feeding could be identified which can serve as a starting point for a tailored breast-feeding support.

The surveys are based on international definitions and recommendations[13,14,16,17], enabling a comparison of results on an international level. The long-term participation rate of about 90 % in both studies indicates sustained high interest of mothers and the suitability of the study design. The prospective assessment minimised recall bias. In SuSe II, the online approach enabled mothers to answer questionnaires within about 15 min, bypassing the postal mail and eliminating the risk of interviewer bias that might have existed during the phone interviews in SuSe I. On the other hand, no queries could be asked during the online survey in case of problems in understanding the questions. In addition, the study design did not allow for verification of the information provided by mothers and hospital staff.

Participation

A weakness of both studies, in particular of SuSe II, is the low response rate of hospitals and mothers. In both

Table 3 Breast-feeding promotion and support in hospitals according to WHO[13,14] and German (G)[18] recommendations and as applied in the SuSe studies

WHO step	Recommendations	SuSe I 175 hospitals (%)	SuSe II 109 hospitals (%)
1	Have a written breast-feeding policy that is routinely communicated to all health care staff (WHO, 1989) Have a written infant feeding policy that is routinely communicated to staff and parents (WHO, 2018) *Have a written breast-feeding policy and a breast-feeding coordinator (G)* ***Have a written breast-feeding policy (SuSe I)* and a breast-feeding coordinator (SuSe II)****	33·1	66·1
2	Train all health care staff in skills necessary to implement this policy (WHO, 1989) Ensure that staff have sufficient knowledge, competence and skills to support breast-feeding (WHO, 2018) *Train all health care staff in theory and practice to implement the guidelines for the promotion of breast-feeding (G)* ***Train health care staff on breast-feeding promotion more than once a year (SuSe I + SuSe II)****	24·0	47·7
3	Train all health care staff in skills necessary to implement this policy (WHO, 1989) Ensure that staff have sufficient knowledge, competence and skills to support breast-feeding (WHO, 2018) *Train all health care staff in theory and practice to implement the guidelines for the promotion of breast-feeding (G)* ***Inform all pregnant women about breast-feeding (SuSe I + SuSe II)*,†***	86·9	48·6
4	Help mothers to initiate breast-feeding within a half hour of birth (WHO, 1989) Facilitate immediate and uninterrupted skin-to-skin contact and support mothers to initiate breast-feeding as soon as possible after birth (WHO, 2018) *Early initiation – if possible within the first hour of life (G)* ***Enable the first initiation of breast-feeding within the first hour of life (SuSe I + SuSe II)*,‡***	93·7	52·3
5	Show mothers how to breastfeed and how to maintain lactation even if they should be separated from their infants (WHO, 1989) Support mothers to initiate and maintain breast-feeding and manage common difficulties (WHO, 2018) *Show mothers how to breastfeed their child and to maintain milk production, even if separated from their child (G)* ***Give mothers breast-feeding instructions and record the instructions in the care documentation (SuSe I + SuSe II)****	54·3	93·6
6	Give newborn infants no food or drink other than breastmilk, unless medically indicated (WHO, 1989) Do not provide breastfed newborns any food or fluids other than breastmilk, unless medically indicated (WHO, 2018) *Additional feeding if medically indicated (G)* ***Additional feeding if medically indicated (SuSe I + SuSe II)****	58·9	70·6
7	Practise rooming-in – allow mothers and infants to remain together – 24 h a day (WHO, 1989) Enable mothers and their infants to remain together and to practise rooming-in 24 h a day (WHO, 2018) *Support mother–child unity – enable 24-h rooming-in (G)* ***Most mothers and infants remain together day and night (SuSe I + SuSe II)*,†***	10·3	95·4
8	Encourage breast-feeding on demand (WHO, 1989) Support mothers to recognise and respond to their infants' cues for feeding (WHO, 2018) *Breast-feeding on demand – breast-feeding should be made possible and encouraged as needed (G)* ***Encourage breast-feeding on demand (SuSe I)* or at least 8–10 times within 24 h without a fixed schedule (SuSe II)****	96·0	98·2
9	Give no artificial teats or pacifier to breast-feeding infants (WHO, 1989) Counsel mothers on the use and risks of feeding bottles, teats and pacifiers (WHO, 2018) *Alternative feeding methods (e.g. cup, finger and spoon feeding) should be shown (G)* ***Use of alternative feeding methods such as cup, spoon or finger feeding if needed (SuSe I + SuSe II)****	9·7	51·4
10	Foster the establishment of breast-feeding support groups and refer mothers to them on discharge from the hospital or clinic (WHO, 1989) Coordinate discharge so that parents and their infants have timely access to ongoing support and care (WHO, 2018) *Encourage the establishment of breast-feeding groups and provide mothers contact information at discharge (G)* ***Refer mothers to a breast-feeding support group on discharge (SuSe I + SuSe II)****	60·3	58·7

Italic: Breast-feeding promotion and support in hospitals according to German recommendations. Bold italic: Breast-feeding promotion and support in hospitals applied in the SuSe studies.
*SuSe I: assessment in 1997; SuSe II: assessment in 2018.
†Multiple answers possible in SuSe I, single choice in SuSe II.
‡Not separated by type of delivery in SuSe I, separated by type of delivery in SuSe II and positive rated, if fulfilled for both.

Table 4 Characteristics of mother–infant pairs in 1997–1998 (SuSe I) and 2017–2019 (SuSe II)

	1997–1998 SuSe I		2017–2019 SuSe II		
Maternal characteristics	*n* 1717†		*n* 962†		*P*-value*
Age (years)‡	30·0	27·0–33·0	33·0	30·0–36·0	<0·001
Nationality (%)					0·098
German	92·9		91·1		
Other	7·1		8·9		
Education (%)					<0·001
Higher secondary	30·9		65·5		
Secondary	49·0		26·8		
Basic + other	20·1		7·6		
Parity (%)					0·090
Primipara	46·3		49·8		
Multipara	53·7		50·2		
Breastfed previous child (%)					0·186
Yes	85·8		88·4		
No	14·2		11·6		
Hospital stay (days)‡,§	5·0	5·0–6·0	3·0	3·0–4·0	<0·001
Delivery (%)					<0·001
Vaginal incl. OP	83·1		68·7		
Caesarean section	16·9		31·3		
Infant characteristics					
Gender (%)					0·717
Female	49·2		49·9		
Male	50·8		50·1		
Birth weight (g)‡	3450·0	3150·0–3757·5	3470·0	3197·5–3760·0	0·289

*Fisher's exact test for categorical variables, Mann–Whitney *U* test for non-normally distributed continuous variables; *P* values <0·05 were considered to be significant.
†SuSe I: *n* 1715 for nationality, *n* 1706 for school education, *n* 1716 for parity, *n* 920 for breastfed previous child and *n* 1665 for hospital stay (days); SuSe II: *n* 959 for age, *n* 955 for school education, *n* 483 for breastfed previous child and *n* 940 for hospital stay (days).
‡Median and 25th–75th interquartile range.
§Outpatient births excluded.

Table 5 Breast-feeding prevalence for different feeding categories during the first year of life in 1997–1998 (SuSe I) and 2017–2019 (SuSe II) (% of all infants*)

	Age of infants (months postpartum)					
	Discharge†	0·5‡	2‡	4	6	12
Feeding categories	1997–1998 – SuSe I					
Exclusive breast-feeding	73	60	42	33	10	–
Predominant breast-feeding	5	15	17	11	3	<1
Full breast-feeding	78	75	59	44	13	<1
Partial breast-feeding (thereof 'Zwiemilch')	8 (8)	10 (10)	11 (11)	15 (7)	35 (<1)	13
Any breast-feeding	86	85	70	59	48	13
No breast-feeding	12	15	30	41	52	87
Feeding categories	2017–2019 – SuSe II					
Exclusive breast-feeding	74	72	68	57	9	–
Predominant breast-feeding	3§	3	4	4	3	–
Full breast-feeding	77	75	72	61	12	–
Partial breast-feeding (thereof 'Zwiemilch')	17 (17)	18 (18)	18 (18)	22 (12)	66 (1)	41
Any breast-feeding	94	93	90	83	78	41
No breast-feeding	6	8	11	17	22	59

*1997–1998: *n* 1717 at discharge and 0.5 months; *n* 1540–1717 2, 4, 6 and 12 months pp; 2017–2019: *n* 962 at discharge and 0.5 months; *n* 835–869 at 2, 4, 6 and 12 months pp.
†Median: 1997–1998: 5 d after birth, 2 % missing (outpatient birth); 2017–2019: 3 d after birth, 0.8 % missing (outpatient birth).
‡Deviations in SuSe II due to rounding.
§Breastmilk and other liquids including formula.

studies, better educated mothers known to be more likely to initiate and maintain breast-feeding were over-represented[31]. The hospital sample in the SuSe II study comprised relatively more baby-friendly hospitals (25·7 % *v.* approx. 15 % currently in Germany)[32]. Therefore, the risk of a selection bias towards an over-estimation of the breast-feeding friendliness in Germany cannot be excluded.

For hospitals, the additional workload of recruiting mothers could have been a main reason for the low participation rate. The additional work was limited to 2 weeks, working hours remained without compensation to the hospitals. In SuSe II, increased time and budget constrains in hospitals may have further tightened the options to participate in a research study[33].

For mothers, a reason for the lower participation rate in SuSe II could be the shortened hospital stay from 5 d (SuSe I) to 3 d (SuSe II). Due to the intense documentation and information requirements as part of routine care, there may not have been enough time for mothers to think thoroughly about their participation in the study. Whether the incentives for mothers in SuSe II increased their willingness to participate could not be analysed with the available data.

The decline in the response rate in the mother–infant cohorts from 52·1 % in SuSe I (1997–1998) to 34·0 % in SuSe II (2017–2019) is comparable to the German nationwide survey on the health of children and adolescents (KiGGS) with a response rate of 66·6 % in the baseline survey (2003–2006) and 38·8 % and 40·1 % in waves 1 (2009–2012) and 2 (2014–2017), respectively[34–36]. In two regional studies in Ulm (Germany), response rates also declined from of 67 % (2000–2001) to 49 % (2012–2013)[37]. The Norwegian Mother and Child Cohort Study (1999–2006) and the Swiss Infant Feeding Study (2014) with 43·5 % and 40 % had similar response rates as our study[38,39]. Thus, the SuSe studies seem to reflect the general decline in willingness to participate in health-related surveys over the past decades[40,41].

Breast-feeding promotion and support in hospitals

Hospitals in SuSe II implemented 7 of the 10 Steps of the WHO breast-feeding promotion to a greater extent than hospitals in SuSe I (Steps 1, 2, 5, 6, 7, 8 and 9). The lower figures in SuSe II for Steps 3 and 4 are due to modified response options in the questionnaire. For Step 3 (breast-feeding information), the response mode was changed from multiple answers to a single one to reduce the probability of a socially desired answer. In Step 4 (first initiation of breast-feeding), the requirements for a positive evaluation had to be met for both types of delivery. In addition, the rate of deliveries by caesarean section was higher in SuSe II (30·0 % *v.* 15·0 %) and theses deliveries are usually associated with later initiation of breast-feeding[42]. Steps 5 (breast-feeding instruction and documentation), 7 (24-h rooming-in) and 8 (breast-feeding on demand) were the best implemented steps in SuSe II, similar to a small hospital survey in the USA published in 2012[43].

Even though only 25·7 % of participating hospitals in SuSe II were certified as baby-friendly, the implementation rate of the respective recommendations was relatively high in our total sample. Positive effects of WHO/UNICEF certification on breast-feeding outcomes were shown in a systematic review[15] but may differ in individual studies[44,45]. A described dose–response relationship between the number of steps to which women remembered being exposed to and the probability of improved breast-feeding outcomes[15] suggests that even non-certified hospitals with a high level of commitment can provide good breast-feeding promotion, as seems to be the case in the SuSe studies.

Breast-feeding prevalence

With more than 90 %, the rates of mothers in the SuSe studies who tried to breastfeed are in the upper range for breast-feeding initiation in national (72–97 %) and European (56–98 %) comparison[46,47]. However, we cannot rule out the possibility that mothers not willing to breastfeed were left out in the recruitment by the hospital staff. The prospective comparison between the SuSe studies showed higher rates of exclusive breast-feeding and 'Zwiemilch' feeding (breast-feeding + non-human milk) until the end of the fourth month pp and any breast-feeding throughout the first year of life in SuSe II.

In a systematic review on breast-feeding data in Germany including 35 single, heterogeneous studies on births between 1990 and 2012, it was not possible to identify clear trends[46]. The SuSe II data range in the upper and middle fields for any breast-feeding between 2 and 6 months and were lower for full breast-feeding 6 months pp compared to the review[46]. A significant decline in breast-feeding rates within the first 2 months of life described in the review[46] was also observed in SuSe I but diminished in SuSe II.

Slight increases in the percentage of women who partially breastfed or breastfed at all at 6 months were observed in two local studies during 1990–2013[48] and 2001–2013[37]. In contrast, between 2001–2014, the retrospective nationwide KiGGS study showed a tendency towards a stabilisation of the duration of any and full breast-feeding and a decrease in full breast-feeding duration between 2009/2010–2013/2014[49]. In the latest KiGGS assessment 2013/2014[49], any breast-feeding rates at 6 months (55·9 %) and 12 months (20·3 %) were lower than in SuSe II (78 % and 41 %, respectively). No breast-feeding data closer to the SuSe II period are available in Germany.

Among eleven selected European countries, the rates for any breast-feeding in the SuSe II study range among the high level countries, for example, the rates for any breast-feeding until 6 months pp were 71 % in Norway, 61 % in Sweden and 52 % in Switzerland[47]. In contrast, the rate for exclusive breast-feeding at 6 months in the SuSe II study is even lower than in general in the WHO European region (9 % and 25 %, respectively)[50]. The decline of exclusive breast-feeding rates between 4 and 6 months pp in SuSe I and II can be explained by the introduction of complementary foods between 4 and 6 months after birth which has been recommended in Germany for more than 20 years[51].

General interpretation

The comparison of the SuSe studies points to an improvement of breast-feeding promotion and support in hospitals and breast-feeding prevalence during the last 20 years. Slight positive trends, as described in other repeated studies in Germany[37,46,48] within almost the same time period, may have become particularly clear in SuSe II as the most recent study.

Hospital environment

Between 2001 and 2017, the number of certified baby-friendly hospitals increased from 6 to 108 in Germany[32] but is still lower than in neighbouring Switzerland (approx. 15 % *v.* 30 %, respectively)[52]. While in SuSe I only 15 % of the hospitals had lactation consultants on the ward, the proportion in SuSe II was over 90 %. In addition to their medical qualification, lactation consultants receive a comprehensive training on breast-feeding and are represented almost nationwide in Germany[53]. Structural efforts, for example, in staff training, support the hypothesis that recent changes in the hospital landscape towards more specialisation and quality improvement might have made hospitals more breast-feeding-friendly over time, although certain structural everyday conditions such as documentation requirements and shorter hospital stays might still hamper effective breast-feeding promotion.

Structural innovations

New federal regulations on parental benefits and parental leave as well as on maternity protection became effective between 2015 and 2017[54,55], and all of them are discussed to be positively associated with breast-feeding duration[56–58]. In parallel, regulations targeting the support of families with low income and in stressful family situations started in 2007[59].

Information campaigns

The long-established free distribution of leaflets with practical breast-feeding recommendations for mothers and hospital staff by the NSK has recently been strengthened by the multimedia information campaigns of the 'Healthy Start – Young Family Network', launched by the German Federal Ministry of Food and Agriculture and the Federal Ministry of Health in 2009, disseminating easy-to-understand recommendations on infant feeding with a special focus on breast-feeding[60].

Since the SuSe studies were conducted 20 years apart, it is neither possible to determine when the increase in breast-feeding friendliness occurred within the 20 years period nor can the positive effects on breast-feeding be attributed to individual direct or indirect measures of increased breast-feeding friendliness.

Perspective

There is still a considerable potential to improve breast-feeding in Germany. In the international research project 'Becoming Breastfeeding Friendly'[61,62], which systematically evaluated breast-feeding promotion in Germany in 2017–2019[63], a moderate score was achieved (1·7 out of 3·0 points)[64]. The conclusions of the project strengthen the need of a multilevel breast-feeding monitoring system in Germany[65]. Prospective studies like SuSe are urgently warranted. To ensure comparisons of the results over time, the design and the use of the international definitions should be maintained but complemented by other study designs that could help to better cover the social diversity of the population. To fulfil the monitoring requirements and allow a timely reaction in breast-feeding promotion measures, the repetitions should be scheduled in shorter intervals[11,65].

Conclusion

SuSe II shows an improvement of breast-feeding promotion in hospitals and of breast-feeding prevalence during the first year of life in Germany compared to the SuSe I study 20 years earlier. Since the participation rates of hospitals and mothers were lower in SuSe II compared to SuSe I, it is not possible to disentangle the potential roles of sample selection or breast-feeding promotion activities for the overall favourable development. In the future, the comprehensive SuSe survey design should be complemented by other approaches to better reflect the diversity of hospitals and mothers for targeted breast-feeding promotion, including increased resources for researchers and hospitals for effective maternal recruitment, particularly given today's short stay on maternity wards.

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All authors critically reviewed the manuscript as submitted. *Ethics of human subject participation:* This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the International Scientific Committee of the Research Institute for Child Nutrition for SuSe I (1997–1998) and by the Ethics Committee of the Medical Faculty of the Ruhr University Bochum for SuSe II (2017–2019). Written informed consents were obtained from all maternity hospitals and mothers.

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4.2 Original Article 2: The role of breastfeeding promotion in German hospitals for exclusive breastfeeding duration [97]

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The role of breastfeeding promotion in German hospitals for exclusive breastfeeding duration

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Abstract

Breastfeeding promotion and support in hospitals is expected to have a positive impact on maternal breastfeeding outcomes. The objective of this study is to examine the association between breastfeeding promotion in maternity hospitals in Germany and exclusive breastfeeding (EBF) rates during the first 4 months. Thus, a nationwide cross-sectional web-based survey of breastfeeding promotion was conducted in 103 hospitals. Mother–infant pairs ($n = 962$) were recruited at these hospitals for a prospective web-based survey of breastfeeding status at five-time points, that is, during a hospital stay, at discharge as well as after 0.5, 2, and 4 months. The hospital analysis was based on the "10 Steps to Successful Breastfeeding" of the World Health Organization and the United Nations Children's Fund, adapted for Germany. Their degree of implementation was stratified by a breastfeeding promotion index (BPI) as low (≤5 steps), medium (6–8 steps), and high (≥9 steps). The association between the BPI and the odds of EBF at each of the five-time points was estimated by multivariable regression models, adjusting for various maternal factors. At all time points, the proportion of EBF among mothers from high BPI hospitals exceeded the proportion of those from medium or low BPI hospitals. A high BPI was associated with higher odds of EBF during the hospital stay and at discharge, while maternal factors for EBF such as breastfeeding experience and no early use of a pacifier persisted beyond. The high commitment of hospitals and tailored support of mothers is essential for EBF.

KEYWORDS

breastfeeding determinants, breastfeeding duration, breastfeeding promotion, exclusive breastfeeding, maternity hospitals, WHO/UNICEF ten steps

1 | INTRODUCTION

Breastmilk is the gold standard for infant nutrition due to its unique nutritional composition along with a multitude of bioactive substances (Ballard & Morrow, 2013). Breastfeeding provides infants with short- and long-term protection against various diseases, depending in part on the intensity and duration of breastfeeding (Horta et al., 2013; Victora et al., 2016). It also offers short- and long-term health benefits to mothers (Victora et al., 2016) and, in addition, breastfeeding is practical.

Exclusive breastfeeding (EBF) is recommended for the first 6 months of life, followed by partial breastfeeding along with age-appropriate complementary feeding (Agostoni et al., 2009; Koletzko et al., 2013; World Health Organisation [WHO] & United Nations Children's Fund [UNICEF], 1990, 2003).

In 1989, the WHO and UNICEF announced a list of interventions called the "Ten Steps to Successful Breastfeeding" (10 steps) to protect, promote, and support breastfeeding in facilities providing maternity and newborn services worldwide (WHO] & UNICEF, 1989). In 2018, an updated implementation guideline was published (WHO & UNICEF, 2018). Implementing the 10 Steps is supposed to significantly improve breastfeeding rates (WHO & UNICEF, 2018).

In addition to breastfeeding promotion and support in the hospital, breastfeeding success also depends on a variety of demographic, psychological, biomedical, and environmental determinants that can play a role, both, pre- and postnatally (Yngve & Sjöström, 2001).

Although most mothers initiate breastfeeding, they often breastfeed shorter than recommended (Victora et al., 2016). In Germany, breastfeeding rates have improved over the last 20 years as shown by the two nationwide studies on breastfeeding and infant nutrition named "SuSe," conducted in 1997–1998 (SuSe I) (Dulon et al., 2003; Kersting & Dulon, 2002) and in 2017–2019 (SuSe II) (Hockamp et al., 2021). In SuSe II, rates for EBF were about 73% during the first 2 weeks after birth, decreased to 68% by 2 months, and then sharply from 57% to 9% between 4 and 6 months (Hockamp et al., 2021), the latter period reflecting the recommended time for introducing complementary feeding in Europe (Fewtrell et al., 2017; Kersting, 2001). Nevertheless, the breastfeeding rates observed in the SuSe II study, whether EBF or breastfeeding at all, were found to be in the upper range in the 11 European countries compared in a survey on national breastfeeding data and monitoring systems (Theurich et al., 2019).

In view of the current relatively high level of breastfeeding in Germany in the SuSe II compared with the SuSe I study, the objective of the present refined analysis was to investigate to what extent and for how long breastfeeding promotion and support in hospitals is relevant for maternal EBF. In addition, potential demographic, psychological, biomedical, and environmental determinants of breastfeeding were considered. Breastfeeding promotion in hospitals was evaluated based on the WHO/UNICEF and German recommendations; breastfeeding was documented repeatedly as EBF during the first 4 months after birth.

Key messages

- A high breastfeeding promotion index (BPI) favours exclusive breastfeeding (EBF) in the hospital environment, while maternal factors persisted beyond.
- Even in a country with a high level of maternal and child care, breastfeeding promotion in hospitals plays a significant role in the successful start of breastfeeding.
- Maternal factors, primarily breastfeeding experience and no early use of a pacifier, were persistent and stronger predictors of EBF than the BPI.
- The steps that need to be improved most refer to breastfeeding information, early breastfeeding initiation, and alternative feeding methods.
- High hospital commitment complemented by tailored, individualised postdischarge support of mothers are critical components for sustained breastfeeding success.

2 | METHODS

2.1 | Study design

SuSe is the abbreviation of the German title of the study *Stillen und Säuglingsernährung (breastfeeding and infant nutrition)*. SuSe II (2017–2019) followed 20 years after SuSe I, maintaining the core structure of the study design to allow data comparison (Hockamp et al., 2021). Thus, the SuSe II study comprises two collectives: Maternity hospitals and mother–infant pairs recruited in the participating hospitals. A cross-sectional survey on breastfeeding promotion was conducted in the hospitals. In addition, a prospective survey on breastfeeding and infant nutrition followed with repeated assessments during the infant's first year of life, most of them during the first 4 months. A detailed description of the study design was published earlier (Hockamp et al., 2021), a brief overview is given below. The study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures were approved by the Ethics Committee of the Medical Faculty of the Ruhr University Bochum. Written informed consents were obtained from hospitals and mothers.

2.2 | Study samples

In September 2017, all hospitals in Germany providing maternity services, hereafter referred to as "hospitals," were invited to participate by postal letter. In case of missing feedback, they were additionally contacted by phone call, fax, and video invitation of the study head. The hospitals were asked to complete a web-based questionnaire on their breastfeeding conditions and to support the study team in recruiting mothers for the follow-up survey. From January to March 2018, a predefined 14-day recruitment period was set for each participating hospital to recruit mothers. The hospital ward staff was requested to document selected basic information of all births. An information letter was handed out if the following inclusion criteria were met: healthy, full-term newborn (birthweight ≥ 2500 g, gestational age ≥ 37 weeks, and no admission to a newborn intensive care unit), sufficient maternal knowledge of the German language for study participation as assessed by the staff, access to a telephone, and the availability of an e-mail address.

2.3 | Assessment of breastfeeding promotion

To evaluate the promotion of breastfeeding in hospitals, the hospital questionnaire was based on the 10-step program of the WHO/UNICEF (2018) and the adapted recommendations for Germany (Bundesinstitut für Risikobewertung, 2007; WHO & UNICEF, 2018).

Similar to the earlier analysis of the SuSe I study, but in a more refined version, a breastfeeding promotion index (BPI) was generated, consisting of 10 items that covered the different areas (Dulon et al., 2003). Each item scored 1 for practicing and 0 for not practicing the particular step (Dulon et al., 2003).

A BPI value between 0 and 10 was achievable. Using the percentiles P_{25}, P_{50}, and P_{75} as cut points, the index was categorised into low (≤5), medium (6–8), and high (≥9) levels of achievement.

2.4 | Assessment of breastfeeding

Participating mothers received an online questionnaire 2 weeks, and 2, 4, 6, and 12 months postpartum (pp). The first questionnaire assessed infant nutrition at 2 weeks and, retrospectively, during the hospital stay and at discharge. This questionnaire additionally assessed maternal and infant characteristics including sociodemographic and feeding information. The follow-up questionnaires on current nutrition remained the same until the age of 12 months.

This evaluation comprises the five-time points within the first 4 months pp as the minimum recommendation for EBF duration: during a hospital stay, at discharge, and after 0.5, 2, and 4 months. Mothers had 4 weeks to answer the questionnaires. To assess breastfeeding success at these time points, two groups were formed: mothers EBF and mothers not EBF at the respective time point. EBF was defined according to the definitions of the WHO/UNICEF meaning the infant receives no other liquids or (semi)solids except breastmilk; vitamins, minerals, or medicine as drops or syrups may be added (WHO, 2008). EBF was categorised using the response options in the maternal questionnaires as presented in Table 1. All other feeding response options were considered as non-EBF. Mothers who had not tried to breastfeed were not included in the analysis.

2.5 | Statistical analysis

Categorically coded characteristics of 916 mother–infant pairs with complete data from the first assessment 2 weeks pp were compared with national statistics if available using the Pearson–Clopper method to calculate exact binomial 95% confidence intervals (CIs). For further analyses, all mother–infant pairs with complete datasets at the considered time points were included. For each time point, the differences between EBF rates among mothers who had given birth in hospitals with high, medium, and low BPI were examined.

To assess the association of the hospital BPI with EBF success, adjusted odds ratios and their corresponding 95% CIs were calculated for each time point, considering potential confounding variables, that is, potential determinants of breastfeeding success other than the BPI.

TABLE 1 Time points assessed and categorisation of exclusive breastfeeding

Time points (pp)	Question	Answer options	Categorisation
At hospital[a]	Did your infant receive any additional fluids other than breastmilk at the hospital?	1. Yes	
		2. No	2. → *EBF*
		3. Don't know	
At discharge[a]	What kind of milk did your infant receive at discharge?	1. Formula only	
		2. Formula + breastmilk	
		3. Breastmilk + other fluids	
		4. Breastmilk only	4. → *EBF*
2 Weeks	*What does your infant receive at present?*	1. Formula only	
		2. Formula + breastmilk	
		3. Breastmilk + other fluids	
		4. Breastmilk only	4. → EBF
2 Months	How many breastmilk meals does your infant receive? + separate questions for fluids, formula, and solids	1. Number of servings/day formula, fluids, and (semi-)solid food	1. Any servings → not EBF
4 Months		2. Number of breastmilk meals day + night	2. No serving in Category 1 → EBF

Abbreviations: EBF, exclusive breastfeeding; pp, postpartum.

[a]Assessed retrospectively 2 weeks after birth.

Analyses were performed using multivariable binary logistic regression with variable selection through backward elimination according to the likelihood ratio. The target variable EBF success was coded 0 for non-EBF and 1 for EBF. The choice of potential confounders was based on literature (Kohlhuber et al., 2008; Yngve & Sjöström, 2001), results from the previous SuSe I study (Dulon et al., 2003) and an earlier basic evaluation of SuSe II (Kersting et al., 2020). To assess effects of breastfeeding promotion over time, model-based probabilities for EBF at the five-time points were calculated, stratified for low, medium, and high BPI, using a logistic mixed model including a random subject effect.

To investigate whether there were steps particularly associated with EBF, each of the 10 steps was analysed with the same multivariable models as the BPI, but the BPI was excluded. Metric independent variables such as maternal age or the hospital size (annual birth rate) were categorised to also consider potentially nonmonotonous influences of the formerly metric variables on the modelled odds.

A $p < 0.05$ was regarded as statistically significant. Data analysis was performed using the IBM® SPSS® Statistics Version 25.0 software package for Windows Version 2016 (IBM Corp.) and R Version 4.0.3 (R Core Team, 2020; R Foundation for Statistical Computing).

3 | RESULTS

3.1 | Participation and inclusion

An overview of the recruitment, participation, and inclusion of hospitals and mothers is shown in Figure 1. Of the total 692 German hospitals invited, 109 participated and 103 recruited a total of 962 mother–infant pairs who participated in the first assessment 2 weeks pp. Initially, 46 mother–infant pairs were excluded from the analysis, either because they had not tried to breastfeed ($n = 33$) or because they had not provided information about all the determinants to be considered in the analyses. In addition, eight mothers were excluded for the time points in the hospital or at discharge, because they did not know the respective breastfeeding status. Seven mothers with an outpatient birth who reported EBF at the hospital (retrospectively) and at the first assessment (2 weeks pp) were classified as EBF at discharge, too. Thus, 916 mothers remained 2 weeks pp, when maternal characteristics and retrospective information on infant feeding in the hospital and at discharge were collected. Finally, 909 mother–infant pairs were included in the analysis of EBF in the hospital, 915 at discharge, 916 after 2 weeks, 830 after 2 months, and 804 after 4 months pp.

3.2 | Breastfeeding promotion in hospitals

The proportion of hospitals with an annual birth rate of more than 1000 births/year was higher in the hospital sample than in the total of maternity hospitals in Germany (50.5% vs. 41.5%) (Wissenschaftliche Information Milupa, 2017). The proportion of hospitals certified "baby-friendly" according to the WHO/UNICEF initiative "Baby-friendly" hospital initiative (BFHI) was higher in the study sample compared with the reported data for Germany (26% vs. approx. 15%) (Verein zur Unterstützung der WHO/UNICEF-Initiative "Baby-freundlich" BFHI e. V. Jahresbericht WHO/UNICEF-Initiative "Babyfreundlich," 2017) (data not shown).

An overview of the implementation of the combined WHO/UNICEF and German recommendations for breastfeeding promotion in the hospital sample ($n = 103$) is presented in Table S1. The three most frequently implemented steps (>93%) were Step 8 (*breastfeeding on demand*), Step 7 (*24-h rooming-in*), and Step 5 (*breastfeeding instruction and documentation*), the three least frequently implemented steps (<54%) were Step 3 (*breastfeeding information*), Step 2 (*regular training of health care staff*), and Step 9 (*alternative feeding methods*) (Table S1).

Initiation of breastfeeding within the first hour of life (Step 4) was enabled by 54.4% of the hospitals after both, vaginal delivery and a caesarean delivery. When specified 74 hospitals (71.8%) practiced it after a vaginal delivery and 58 hospitals (56.3%) after a caesarean delivery, others did not practice this step at all.

Hospitals implemented a median of seven steps ($P_{25} = 5$; $P_{75} = 8$), with a minimum of 2 steps (1 hospital; 1.0%) and a maximum of 10 steps (9 hospitals; 8.7%) (Table S2). Between 1 and 30, mother–infant pairs per hospital participated in the study (Table S2). Among mothers who had given birth in a hospital with a high BPI, 95.5% ($n = 236$) had stayed in certified hospitals and 4.5% ($n = 11$) in noncertified hospital.

3.3 | Sample characteristics of mothers and infants

The mother–infant sample was compared with national data as available in Table 2 (Institut für Qualitätssicherung und Transparenz im Gesundheitswesen, 2017, 2018; Statistisches Bundesamt [Destatis], 2020). Higher proportions of SuSe II mothers were in the older age categories, had a higher level of education, were more often primiparous, and had a longer hospital stay compared to national data. A lower proportion had a vaginal delivery and an infant with a birth weight between 2500 and 2999 g.

Mothers stayed in the hospital for an average of 3.5 days (median 3; range: 0–15); stratified by the type of delivery, the average was 3.1 days (3; 0–12) after a vaginal delivery and 4.3 days (4; 2–15) after a caesarean section.

3.4 | Breastfeeding rates

The rates for EBF continuously decreased after discharge from 77.4% to 58.8% 4 months pp (Table S3).

3.5 | Hospital breastfeeding promotion and maternal breastfeeding success

At all five-time points, the proportion of EBF was higher among mothers who gave birth in hospitals with a high BPI (89.0%–62.7%) compared to those with a medium (74.6%–58.3%) or low BPI

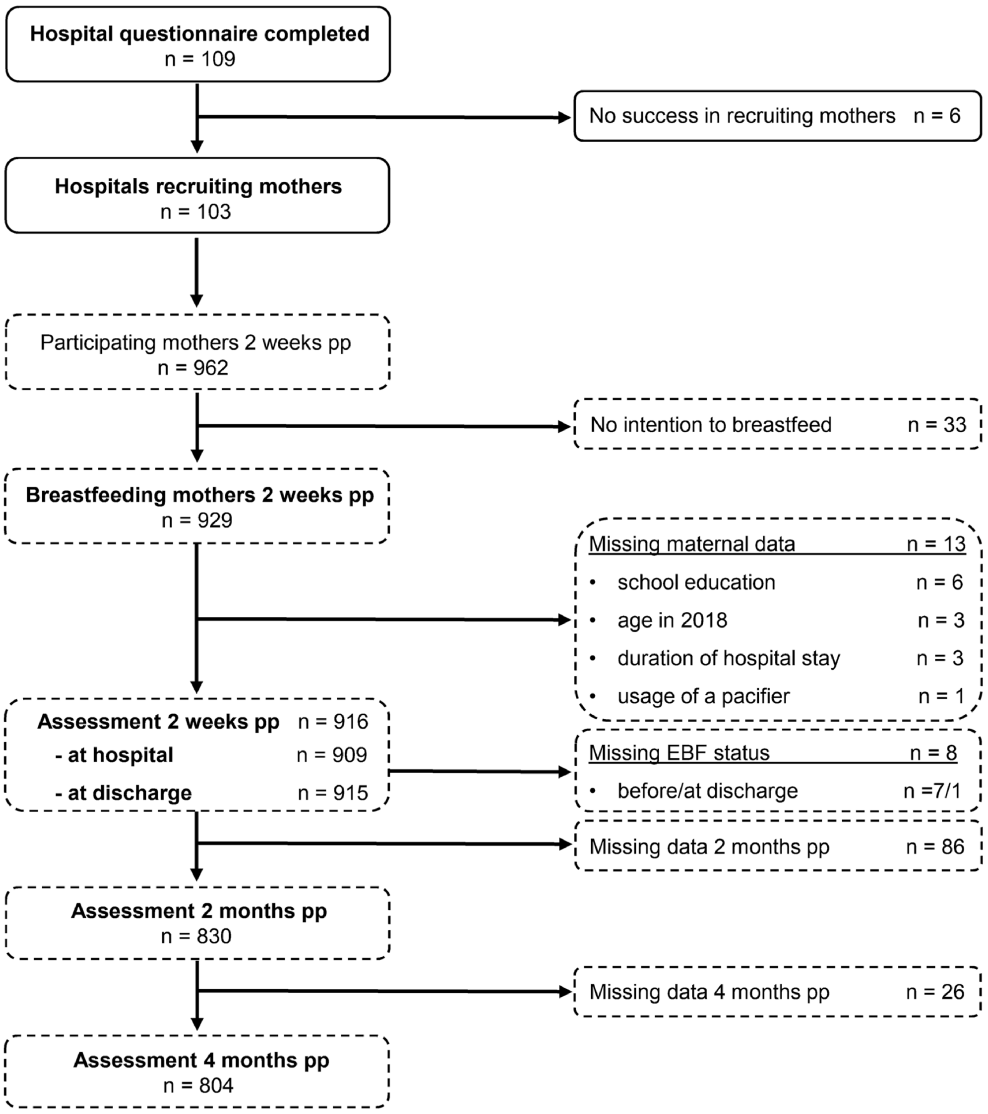

FIGURE 1 Flowchart of participation and inclusion in the study. EBF exclusive breastfeeding; pp postpartum

(73.8%–56.1%). The proportion of EBF differed only marginally between medium and low BPI, except at 2 months pp (Figure S1). Between 2 weeks and 4 months pp, rates of EBF in the high BPI group approached those in the medium and low BPI groups.

In the multivariable models, considering potential determinants for breastfeeding, the BPI level was significantly associated with EBF at the first two-time points but not anymore after the hospital stay: mothers from hospitals with a high BPI had 2–3 times higher odds of EBF in the hospital and at discharge compared to mothers from hospitals with a low BPI (Table 3).

Among maternal characteristics, having breastfeeding experience or not using a pacifier within the first 2 weeks pp was associated with higher odds of EBF for all time points examined. At four of the five-time points, vaginal delivery and no breastfeeding problems within 2 weeks pp increased the odds of EBF, whereas a low level of education and being undecided about the duration of breastfeeding decreased the odds of EBF (Table 3). Other characteristics showed no or no such consistent associations.

The short-term role of the hospital and the persistent importance of maternal factors on EBF were clearly confirmed by the logistic mixed model fit with a random subject effect (data not shown).

Only 3 out of the 10 steps were consistently significantly associated with EBF (at least two-time points consecutively) (Table 4). Surprisingly, mothers from hospitals that provided prenatal information about breastfeeding and written material at the hospital (Step 3) had 30% lower odds of EBF after discharge compared to mothers from hospitals that did not provide such information. Regarding feeding practices, early *initiation of breastfeeding* (Step 4) and provision of

TABLE 2 Sample characteristics of mothers and infants compared to national data

Maternal characteristics	Study sample[a,b] n = 916 n	(%)	95% CI	National data[b] n	(%)	95% CI
Age (years)				n = 761,176[c]		
<18	0	(0.0)	0.00–0.40	3890	(0.5)	0.50–0.53
18–29	199	(21.7)	19.09–24.54	300,357	(39.5)	39.35–39.57
30–34	383	(41.8)	38.59–45.08	270,658	(35.6)	35.45–35.67
35–39	273	(29.8)	26.86–32.88	153,841	(20.2)	20.12–20.30
≥40	61	(6.7)	5.13–8.47	32,430	(4.3)	4.22–4.31
School education				n = 16,798[d]		
Higher secondary	612	(66.8)	63.66–69.86	7310	(43.5)	42.77–44.27
Secondary	244	(26.6)	23.80–29.63	4846	(28.9)	28.16–29.54
Basic + other[e]	60	(6.6)	5.04–8.35	4642	(27.6)	26.96–28.32
Country of birth				n = 758,614[c]		
Germany	806	(88.0)	85.71–90.03	576,825	(76.0)	75.94–76.13
Other	110	(12.0)	9.97–14.29	181,789	(24.0)	23.87–24.06
Parity				n = 761,176[c]		
Primipara	464	(50.7)	47.37–53.94	358,864	(47.2)	47.03–47.26
Multipara	452	(49.3)	46.06–52.63	402,312	(52.9)	52.74–52.97
Delivery				n = 626,830[c,f,g]		
Vaginal incl. OP	635	(69.3)	66.22–72.30	471,578	(75.2)	75.13–75.34
Caesarean section	281	(30.7)	27.70–33.78	154,850	(24.7)	24.60–24.81
Partnership				n = 758,614[c]		
Steady	891	(97.3)	96.00–98.23	694,629	(91.6)	91.50–91.63
Single	25	(2.7)	1.77–4.00	63,985	(8.4)	8.37–8.50
Hospital stay (days)				n = 761,201[c]		
0	19	(2.1)	1.25–3.22	22,471	(3.0)	2.91–2.99
1–2	140	(15.3)	13.01–17.78	208,733	(27.4)	27.32–27.52
3–6	728	(79.5)	76.71–82.05	514,861	(67.6)	67.53–67.74
>6	29	(3.2)	2.13–4.52	15,136	(2.0)	1.96–2.02
Infant characteristics						
Sex				n = 776,188[c,h]		
Male	460	(49.8)	46.93–53.51	378,123	(48.7)	48.60–48.83
Female	456	(50.2)	46.49–53.07	397,948	(51.3)	51.16–51.38
Birth weight category (g)				n = 721,641[c]		
2500–2999	114	(12.4)	10.38–14.76	120,429	(16.7)	16.60–16.77
3000–3499	359	(39.2)	36.02–42.44	521,850	(72.3)	72.21–72.42
3500–3999	339	(37.0)	33.87–40.23			
≥4000	104	(11.4)	9.37–13.59	79,362	(11.0)	10.93–11.07

Abbreviation: 95% CI, 95% confidence interval.

[a]2 Weeks postpartum.

[b]Deviations due to rounding.

[c]Institute for Quality Assurance and Transparency in Health Care 2017 for age, parity, delivery, hospital stay, infant gender, and birth weight (Institut für Qualitätssicherung und Transparenz im Gesundheitswesen, 2018), and Institute for Quality Assurance and Transparency in Health Care 2016 for country of origin, employed before maternity protection, and partnership (Institut für Qualitätssicherung und Transparenz im Gesundheitswesen, 2017).

[d]German Federal Statistical Office 2018 for school education (Statistisches Bundesamt [Destatis], 2020).

[e]Other: Polytechnic secondary school or no degree (yet).

[f]Mature singletons (37–41 weeks of pregnancy) from a regular cranial position.

[g]Other delivery (unspecified): $n = 402$ (0.06%), category excluded.

[h]Sex undefined: $n = 117$ (0.02%), category excluded.

alternative feeding methods instead of bottles (Step 9) were supportive factors for EBF, but only in the early postnatal period.

4 | DISCUSSION

In this national sample of hospitals and mothers, a high BPI level was associated with the start of EBF in the hospital environment, while various maternal factors played a longer-term role beyond discharge, as confirmed by both of our statistical models. This high engagement by hospitals was effective even in a country with a high level of maternal and child care like Germany. However, additional targeted support for mothers is required pre- and postnatally, and both individually and on a public health level. Our present analysis performed on a higher breastfeeding rate confirmed the results from the SuSe I study 20 years earlier that maternal factors were stronger predictors for EBF than the BPI.

4.1 | Hospitals

4.1.1 | Breastfeeding promotion index

In a worldwide systematic review, a dose-response relationship has been suggested between the number of supportive measures within the 10 steps, that is, the level of BPI a mother is exposed to and the likelihood of EBF at hospital discharge and the duration of EBF (Pérez-Escamilla et al., 2016). The SuSe II analysis confirmed this relationship for the hospital environment at the highest level of BPI ranking (≥9 steps), suggesting that not even a medium BPI (6–8 steps) was sufficient to adequately promote EBF in this hospital sample. The high proportion of BFHI-certified hospitals in our sample supported the analysis of a wide range of BPI levels in hospitals, which shows that exceptionally high and structured engagement of hospitals is needed and promising to get breastfeeding successfully started in a population with an overall high level of maternal care.

Recent studies from Europe (Belgium, Switzerland) (Robert et al., 2019; Spaeth et al., 2018) and the U.S. (Ducharme-Smith et al., 2021) that directly aimed to compare breastfeeding rates of mothers from BFHI certified and noncertified hospitals, used different study designs and measurement time points. However, similar to our study, they did not find convincing longer-term associations between breastfeeding promotion in hospitals and maternal EBF. The differing observations in the worldwide evaluations of BFHI implementation (Pérez-Escamilla et al., 2016; WHO & UNICEF, 2018) compared with these single studies in high-income countries suggest that the cultural context of mother–child care in a country may play an important role (Aryeetey & Dykes, 2018).

4.1.2 | Individual steps

While the 10 steps as a whole may best reflect the complexity of breastfeeding, targeted interventions require knowledge about the role of individual steps. In fact, the WHO reviewed the scientific evidence of the intervention fields for the "critical" breastfeeding outcomes and concluded that the overall quality of evidence of two of the 10 steps is partly high: for Step 4, this refers to the association of early breastfeeding initiation and neonatal mortality, while the evidence is moderate for EBF outcomes (WHO, 2017). For Step 9, the quality of evidence is high for no association between pacifier use and breastfeeding outcomes and moderate for the avoidance of bottle feeding among term infants (WHO, 2017). Interestingly, these two steps were relevant in this evaluation as well as in the Swiss study, where the implementation of the steps was reported by mothers (Spaeth et al., 2018).

The finding of our study that mothers from hospitals that implemented Step 4 (*first initiation of breastfeeding within the first hour of life*) had higher odds of EBF throughout the first 2 weeks pp shows that even under optimal health care conditions and with a low neonatal mortality rate (WHO, 2020), the awareness of early breastfeeding initiation in hospitals remains essential. As only about half of the hospitals practiced Step 4 for both, vaginal and caesarean deliveries, there is an urgent need to close this gap. This applies in particular to caesarean deliveries, as these may delay and complicate breastfeeding initiation (Economou et al., 2018; Hakala et al., 2017). Early initiation is a core indicator for monitoring breastfeeding worldwide (WHO, 2008), its implementation may be improved by including this parameter in perinatal quality management systems (Euro-Peristat 2012; Euro-Peristat Project, 2018).

Alternative feeding methods (Step 9), recommended when infants have difficulty being fed at the breast, require experienced personnel for adequate and proper guidance of the mothers. Only

TABLE 3 Factors for exclusive breastfeeding (BF) at five-time points during the first 4 months of life[a,b]

	Basic distribution n = 916 n (%)	At hospital n = 909 OR (95% CI)	At discharge n = 915 OR (95% CI)	2 Weeks pp n = 916 OR (95% CI)	2 Months pp n = 830 OR (95% CI)	4 Months pp n = 804 OR (95% CI)
Hospital BF promotion						
BPI						
High	247 (27.0)	3.86*** (2.34–6.37)	2.06** (1.27–3.35)			
Medium	390 (42.6)	1.05 (0.73–1.49)	1.06 (0.73–1.56)	///[c]	///[c]	///[c]
Low	279 (30.5)	1***	1**			
Maternal characteristics						
Education						
Basic + other	60 (6.6)	0.70 (0.36–1.36)		0.42** (0.23–0.78)	0.51 (0.26–1.01)	0.36** (0.18–0.75)
Secondary	244 (26.6)	0.55** (0.38–0.78)	///[c]	0.63* (0.43–0.91)	0.46*** (0.31–0.66)	0.62** (0.44–0.88)
Higher secondary	612 (66.8)	1**		1**	1***	1**
BF experience						
Yes	413 (45.1)	1.63** (1.16–2.30)	1.92*** (1.34–2.75)	1.77** (1.24–2.52)	2.19*** (1.54–3.13)	1.82*** (1.33–2.51)
No	503 (54.9)	1	1	1	1	1
Partner's attitude towards BF						
Positive	842 (91.9)	1.87* (1.10–3.18)	///[c]	1.99* (1.14–3.46)	1.76 (1.00–3.10)	///[c]
Other	74 (8.1)	1		1	1	
Pregnancy and birth						
BF duration intention[d]						
No idea/insecure	99 (10.8)		0.30*** (0.19–0.49)	0.17*** (0.10–0.28)	0.22*** (0.13–0.37)	0.23*** (0.13–0.40)
As long as possible	218 (23.8)	///[c]	1.00 (0.66–1.51)	0.52** (0.35–0.77)	0.70 (0.47–1.04)	0.99 (0.68–1.44)
At least 4 months	599 (65.4)		1***	1***	1***	1***
Cigarette smoking during pregnancy						
No	868 (94.8)	0.46 (0.20–1.03)	///[c]	///[c]	2.70* (1.21–6.05)	2.50* (1.08–5.79)
Yes	48 (5.2)	1			1	1
Delivery						
Vaginal incl. OP	635 (69.3)	///[c]	1.76** (1.24–2.49)	1.55* (1.09–2.20)	1.54* (1.08–2.20)	1.51* (1.09–2.11)
Caesarean section	281 (30.7)		1	1	1	1

TABLE 3 (Continued)

	Basic distribution *n* = 916 n (%)	At hospital *n* = 909 OR (95% CI)	At discharge *n* = 915 OR (95% CI)	2 Weeks pp *n* = 916 OR (95% CI)	2 Months pp *n* = 830 OR (95% CI)	4 Months pp *n* = 804 OR (95% CI)
Postnatal conditions						
Hospital stay (days)						
≤3	570 (62.2)	1.56** (1.12–2.16)	///[c]	///[c]	///[c]	///[c]
>3	346 (37.8)	1				
BF problems[e]						
No	437 (47.7)	1.89*** (1.33–2.69)	2.95*** (2.04–4.26)	2.93*** (2.04–4.20)	1.89** (1.31–2.72)	///[c]
Yes	479 (52.3)	1	1	1	1	
Nipple shield use[e]						
No	584 (63.8)	1.75** (1.24–2.47)	///[c]	///[c]	1.51* (1.06–2.15)	1.83*** (1.33–2.52)
Yes	332 (36.2)	1			1	1
Pacifier use[e]						
No	274 (29.9)	1.63* (1.11–2.40)	2.22*** (1.46–3.37)	2.60*** (1.71–3.93)	2.20*** (1.48–3.25)	2.07*** (1.46–2.92)
Yes	642 (70.1)	1	1	1	1	1

Abbreviations: 95% CI, 95% confidence interval; BPI, breastfeeding promotion index; OR, odds ratio; pp, postpartum.

[a]Adjusted ORs and their corresponding 95% CIs were calculated for each time point using multivariable binary logistic regression with variable selection through backward elimination according to the likelihood ratio.

[b]Further variables in the models with no significant associations: maternal age and hospital size (no. of births in 2016).

[c]Variable not in the final model.

[d]"Full" BF (exclusive BF including the administration of water and water-based drinks).

[e]Within the first 2 weeks pp.

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

TABLE 4 Odds for exclusive breastfeeding after exposure to the individual steps of hospital breastfeeding (BF) promotion[a,b,c]

	Basic distribution *n* = 916 n (%)	At hospital *n* = 909 OR (95% CI)	At discharge *n* = 915 OR (95% CI)	2 Weeks pp *n* = 916 OR (95% CI)	2 Months pp *n* = 830 OR (95% CI)	4 Months pp *n* = 804 OR (95% CI)
Mothers exposed to individual steps						
Step 1 (*written BF policy + BF coordinator*)						
Yes	663 (72.4)	///[d]	0.70 (0.46–1.04)	///[d]	///[d]	///[d]
No	253 (27.6)		1			
Step 2 (*regular training of health care staff*)						
Yes	505 (55.1)	1.38 (0.96–1.99)	///[d]	///[d]	///[d]	///[d]
No	411 (44.9)	1				
Step 3 (*BF information*)						
Yes	440 (48.0)	///[d]	///[d]	0.70* (0.50–0.98)	0.68* (0.48–0.97)	0.73* (0.53–0.99)
No	476 (52.0)			1	1	1
Step 4 (*first initiation*)						
Yes	455 (49.7)	1.46* (1.04–2.05)	1.83** (1.29–2.59)	1.43* (1.01–2.02)	///[d]	///[d]
No	461 (50.3)	1	1	1		
Step 6 (*additional feeding only if medically indicated*)						
Yes	632 (69.0)	///[d]	///[d]	///[d]	1.50* (1.04–2.17)	///[d]
No	284 (31.0)				1	
Step 8 (*BF on demand*)						
Yes	898 (98.0)	///[d]	///[d]	///[d]	6.45** (2.10–19.78)	///[d]
No	18 (2.0)				1	
Step 9 (*use of alternative* feeding methods)						
Yes	486 (53.1)	1.91*** (1.34–2.74)	1.54* (1.07–2.24)	///[d]	///[d]	///[d]
No	430 (46.9)	1	1			

Abbreviations: 95% CI, 95% confidence interval; OR, odds ratio; pp, postpartum.

[a]Adjusted ORs and their corresponding 95% CIs were calculated for each time point using multivariable binary logistic regression with variable selection through backward elimination according to the likelihood ratio.

[b]Adjusted for the individual steps (Steps 1–10 represented in bold); further adjusted for maternal age, maternal education, BF experience, partner's attitude towards BF, "full" BF duration intention (exclusive breastfeeding including the administration of water and water-based drinks), cigarette smoking during pregnancy, delivery, hospital stay, breastfeeding problems within the first 2 weeks pp, nipple shield use within the first 2 weeks pp, pacifier use within the first 2 weeks pp, and hospital size (no. of births in 2016).

[c]Steps not in the final model at any time: Steps 5 (*BF instruction + documentation*), 7 (*24-h rooming-in*), and 10 (*ongoing BF support*).

[d]Variable not in the final model.

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

about half of the hospitals offered alternative feeding methods, the remaining used bottles. Provision of alternative feeding methods in hospitals favoured EBF during hospital stay confirming that qualified breastfeeding support is essential. This is similarly relevant to increase the implementation of early breastfeeding initiation (Step 4).

Results for Step 3 (*breastfeeding information*) were unexpected. Mothers who gave birth in hospitals that had implemented Step 3 had consistently lower odds of EBF after 2 weeks pp compared with mothers from hospitals that were not fully compliant. Unfortunately, the hospital questionnaire did not specify whether educational material was combined with personal support to effectively increase breastfeeding (Wouk et al., 2017). However, it can be speculated that the prenatal information settings addressed by the hospitals may have focused on the upcoming delivery rather than on breastfeeding.

4.2 | Maternal factors

Many of the known maternal social, psychosocial, and perinatal factors (Kohlhuber et al., 2008; Sievers et al., 2003; Yngve & Sjöström, 2001)

for breastfeeding were also relevant for EBF here, but, what is new, persisted much longer than the BPI.

4.2.1 | Sociopsychological background

A lower social status decreased the odds of EBF, similar to factors like lack of breastfeeding intentions and experience. Fathers may play an additional role (Crippa et al., 2021). As peer support has been shown to be particularly effective for hard-to-reach groups (Sokol & Fisher, 2016), our results suggest that involving mothers with breastfeeding experience could complement professional assistance such as post-discharge midwifery support. The results for Step 3 (*breastfeeding information*) show the need for suitable information by the hospital as an integrated link in the information chain.

4.2.2 | Perinatal conditions

The fact that a vaginal delivery favoured EBF may be partly attributable to the early initiation of breastfeeding, as discussed for Step 4. Together with the increased odds of EBF with a shorter hospital stay, complication-free childbirth may have favoured breastfeeding.

Mothers' reported use of pacifiers during the first 2 weeks pp was a persistent risk factor for non-EBF, in line with the use of nipple shields. As breastfeeding problems in the first 2 weeks were also persistently associated with EBF, reverse causality has to be considered, that is, inappropriate pacifier use may be both, the cause and the result of breastfeeding problems. In view of the potentially protective role of pacifier use for sudden infant death (Alm et al., 2016) and the potential risk for non-EBF, pacifiers should only be used cautiously and accompanied by professional guidance especially in the phase of breastfeeding establishment (American Academy of Pediatrics, 2012; Braga et al., 2020; Buccini et al., 2017; Lubbe & Ham-Baloyi, 2017).

4.3 | Strength and limitations

A major strength of the SuSe II study is the targeted linkage of nationwide data from hospitals with comprehensive data from mothers with prospective breastfeeding assessments in the critical neonatal period. In addition, the application of international standards (WHO, 2008; WHO & UNICEF, 2018) for measuring the exposure (BPI) and the outcome (EBF) allows the results to be comparable across national borders.

A major weakness of the study is the low participation rate among hospitals (16%) and mothers (34%) (Hockamp et al., 2021), although similar to other public health studies (Gross et al., 2014; Hoffmann et al., 2018; Lange et al., 2014; Nilsen et al., 2009). The overrepresentation of certified baby-friendly hospitals together with the additional effort for the hospital staff to recruit mothers may have led to an overestimation of the breastfeeding friendliness of German hospitals. On the other hand, the certified hospitals that implemented the steps to the expected high degree helped to demonstrate that a high score plays an important role in breastfeeding success. In addition, mothers with a higher level of education who are likely to initiate and maintain breastfeeding were overrepresented (Cohen et al., 2018). Unfortunately, a direct comparison with the similar analysis in the previous study, SuSe I, conducted 20 years earlier, was not possible due to the lower BPI level (median of five steps), stratification into only two BPI categories, and full breastfeeding (EBF including water and water-based drinks) instead of EBF as the outcome variable. However, both SuSe studies show that maternal factors were stronger predictors of breastfeeding success than the BPI (Dulon et al., 2003).

5 | CONCLUSION

Even in countries with a relatively high level of breastfeeding and a high-quality mother–infant care system, it is essential to encourage hospitals to engage in breastfeeding support. Their high commitment needs to be complemented by tailored support of mothers, as a critical component for sustained breastfeeding.

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CONFLICTS OF INTEREST

Mathilde Kersting and Erika Sievers were members of the German National Breastfeeding Committee between 1994 and 2021 (Mathilde Kersting) and between 2008 and 2021 (Erika Sievers). Silvia Rudloff is a member of the Nutrition Committee of the German Society of Pediatrics and Adolescent Medicine. Other authors have reported no conflicts of interest.

AUTHOR CONTRIBUTIONS

MK designed the research and supervised the manuscript. NH conducted the research and drafted the manuscript. NH and PH analysed the data. HR supervised the data analysis. ES provided essential support for data interpretation. SR gave advice on human milk research. MK and TL had primary responsibility for the final content. All authors read and approved the final manuscript.

DATA AVAILABILITY STATEMENT

Data are available on request from the authors.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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5. Discussion

On the following pages, the presented publications will be discussed, beginning with a synopsis of the research results and continuing with the implications the findings raise for breastfeeding in Germany in the context of breastfeeding promotion.

5.1 Synopsis of Research Results

The SuSe studies, combining cross-sectional surveys in maternity hospitals and prospective surveys of mother-infant pairs, provide an important contribution to the database on breastfeeding and infant nutrition during the first year of life and breastfeeding promotion in maternity hospitals in Germany. Despite its limitations, SuSe differs from other studies because of its study design, the consequent use of national and international recommendations and definitions, and its repetition after 20 years using a similar design. The comparison of SuSe I and SuSe II suggests that both, maternal breastfeeding behavior and breastfeeding promotion in maternity hospitals have converged toward the recommendations over a period of 20 years. Seven of the 10 Steps were implemented to a greater extent in SuSe II hospitals than in SuSe I hospitals and more mothers exclusively breastfed for 4 months (57% vs. 33%) and continued partial breastfeeding until 12 months (41% vs. 13%) [96]. These improvements occurred in the context of efforts to promote breastfeeding at the international and national level over the last decades [10–13,61,86], as outlined in the introduction. As stated in the introduction as well, numerous determinants at different levels contribute to maternal breastfeeding behavior and breastfeeding success [8,9]. In SuSe II, a high level of breastfeeding promotion in the hospital favored exclusive breastfeeding in the hospital setting, while maternal factors such as no early use of a pacifier, pre-existing breastfeeding experience, absence of breastfeeding problems within the first 2 weeks pp, prenatal breastfeeding intention, or mode of delivery were stronger predictors of breastfeeding success as measured by exclusive breastfeeding in the first 4 months of life [97]. Although these findings only reflect determinants of breastfeeding in the SuSe II collective and cannot be generalized to all mothers and maternity hospitals in Germany, they can still provide important insights for breastfeeding promotion, which are addressed and discussed below.

5.2 Breastfeeding Rates

5.2.1 Global Trends

Looking at global data from WHO and UNICEF, the rates for exclusive breastfeeding for children under 6 months of age increased from 44% to 48% between 2013–2018 and 2015–2021, and are 10 percentage points higher than a decade earlier, close to the WHA target of 50% by 2025. Within these period, the percentage of children who were breastfed at 1 year of age also increased slightly from 68% to 70% [57,98].

In low- and middle-income countries, breastfeeding recommendations are more likely to be achieved than in high-income countries, and data quality is reported to be high [3]. From 2000–2009 to 2010–2018, an increase of about 10% in exclusive breastfeeding of infants younger than 6 months, but a decrease of about 2% in continued breastfeeding at 1 year was observed in 44 selected low- and middle-income countries [99]. In 2010–2018, the weighted prevalence was 46% for exclusive breastfeeding under 6 months and 83% for continued breastfeeding at 1 year [99]. Neves et al. observed an improvement in exclusive breastfeeding rates for infants younger than 6 months from about 35% in 2000 to about 49% in 2019 in low- and middle-income countries, but also a slight decline in low-income countries for breastfeeding at 1 year [100].

Only few high-income countries collect breastfeeding indicators in a standardized way according to the current WHO guidelines [3,101]. This makes it difficult to monitor the WHO breastfeeding recommendations, especially in relation to the variability of the time frame for exclusive breastfeeding under 6 months [100,101]. Available data on breastfeeding trends in 51 high-income countries suggest that breastfeeding practices have improved in most countries over the years, with a median value of 42% and 18% for exclusive breastfeeding at 4 and 6 months, respectively, and 29% for continued breastfeeding at 1 year [101]. An increase in breastfeeding at 6 months and 1 year was also observed from 2000 to 2019 by Neves et al. [100].

An example of a high-income country that illustrates how difficult it is to compare breastfeeding rates between countries with different recommendations is Austria, where the “Säuglings- und Kinderernährung” (SUKIE) study was conducted between 2019–2020 [102]. The proportion of infants younger than 6 months who had received exclusively breastmilk was presented separately according to WHO (0–182 days) and Austrian (0–120 days) definitions. While the WHO recommendation was reached by only 1.9% of the participating mothers, the recommendation for Austria, which corresponds to that of ESPGHAN [6] and Germany [7], was still reached by 30.5% of the participating mothers [102].

The studies cited above identified great differences in breastfeeding practices across countries, which, in addition to methodological issues, may reflect discrepancies in, e.g., social culture, national policies, maternity services, maternity education, wealth, and different national recommendations across countries [3,99,101]. For example, breastfeeding duration is positively associated with women's education and wealth in high-income countries [103], while the opposite is true in low- and middle-income countries: poor women breastfeed longer than rich women [3,104]. These findings indicate that breastfeeding support strategies need to be tailored to the specific determinants identified in each country [3] as intended by the international BBF project [53,66].

There are hypotheses for the decline in continued breastfeeding in low- and middle-income countries [100]. The high rates of continued breastfeeding may be due to long-standing cultural practices rather than to breastfeeding promotion activities [9], which have focused more on young infants, for whom exclusive breastfeeding is an important safeguard against mortality from infectious diseases [3]. The decline may be due to increased urbanization and adoption of Western lifestyles, as family wealth is inversely associated with breastfeeding duration in low- and middle-income countries [100,104].

However, the positive trends in high-income countries as well as the overall increase in exclusive breastfeeding are consistent with global and national efforts to improve, support, and promote breastfeeding [100].

5.2.2 Germany

The results of the two SuSe studies are in line with the described positive trends in breastfeeding rates in high-income countries, even though the recommendations for the introduction of complementary feeding differ between Germany [7] and the WHO [51]. A systematic review of 35 breastfeeding studies from Germany for birth cohorts of 1990–2012 could not identify clear changes in breastfeeding rates over time [94]. This might be due to the heterogeneous survey designs, as discussed as a limitation of the authors [94]. However, two study results not included in this systematic review, the KiGGS Wave 2 and "Dortmund Nutritional and Anthropometric Longitudinally Designed" (DONALD) study, showed a trend towards an increase in any breastfeeding between the birth cohorts of 2009/2010 and 2013/2014 and between 1990–2013, while the prevalence of full and exclusive breastfeeding showed no clear changes [105,106]. Looking at recent numbers from KiGGS Wave 2, 40.0% and 12.5% of infants were exclusively breastfed until the age of at least 4 and 6 months, respectively (birth cohorts of 2012-2016), and 20.3% were partially breastfed at 12 months of age (birth cohorts of 2013/2014) [105]. In contrast, in KiGGS Wave 1, 34.0% of infants in the birth cohorts of 2002–2012 were exclusively breastfed for at least 4 months [107].

Whether the higher prevalence of breastfeeding in SuSe II was due to methodological reasons or to a selection of mothers with an interest in breastfeeding, as discussed in Section 5.4, or whether the time of implementation of the study played a role and thus the possibility that breastfeeding promotion measures had more time to unfold their effect, cannot be clearly determined.

Nevertheless, there are certain factors, such as early breastfeeding problems or unclear perceptions of breastfeeding duration, that lead some mothers to be unable or unwilling to achieve the recommendations for exclusive breastfeeding in the first 4 to 6 months pp and for continued breastfeeding after the introduction of complementary feeding. Which factors may have had a positive or negative impact on breastfeeding rates in SuSe, will be discussed next.

5.3 Framework Conditions for Breastfeeding

5.3.1 The Role of Maternity Hospitals

Although the number of hospitals with maternity wards in Germany has declined in recent decades [108], almost all childbirths (~98%) take place in a hospital setting [109]. Thus, these hospitals have a direct impact on the sensitive time around childbirth on almost all mothers.

5.3.1.1 Postpartum Hospital Stay and Day of Delivery

In the years of the recruitment for SuSe I and SuSe II which was in 1997 and in 2018, respectively, a similar number of deliveries were documented in maternity hospitals in Germany: 795,274 (SuSe I) and 757,878 (SuSe II) [110]. However, in SuSe II, the number of maternity hospitals in which the children were born was lower compared to SuSe I accompanied by a reduction in the median length of hospital stay after delivery from 5.3 days in SuSe I to 3.0 days in SuSe II [96]. In terms of readmission rates, the findings of a Canadian study published in 2016 including 1,875,322 live births indicate that readmission rates are lowest for stays of 1–2 days after a vaginal delivery and 2–4 days after delivery by Cesarean section, when outpatient support in the community is provided [111]. In terms of breastfeeding, early discharge from the hospital < 48 hours pp and hospital discharge before effective breastfeeding is established are described as risk factors for breastfeeding difficulties [112] and require increased breastfeeding support [113]. An U.S. study including 10,519 childbearing women who responded to the California Maternal and Infant Health Assessment surveys 2 months pp, showed after adjustment for several potential confounders such as education, parity and family income, that women with a shorter or longer pp hospital stay compared to standard stays of 2 nights following a vaginal delivery and 4 nights following a Cesarean section had a slightly increased risk of terminating breastfeeding early (Relative Risk (RR) [95% Confidence Interval (95% CI)]: 1.11 [1.01–1.23]) and may have had a greater need for support to continue breastfeeding [114]. The authors suggested that unmeasured confounders affecting maternal and infant health in case of a long stay or the quality of in hospital breastfeeding support in case of a short stay may have affected their results [114].

Mothers in SuSe II had a longer pp hospital stay compared to national data from official statistics (3–6 days: SuSe II 79.5% vs. national data 67.6%) [97]. This could possibly be explained by study recruitment in SuSe II: the ward staff had fewer opportunities to recruit mothers for the study during a short pp stay. In addition, a hospital stay of more than 3 days was negatively associated with exclusive breastfeeding at the hospital itself in SuSe II, since mothers with a hospital stay of 3 days or less had higher odds of exclusive breastfeeding at the hospital (Odds Ratio (OR) [95% CI]: 1.56 [1.12–2.16]); however, other factors such as existing breastfeeding experience or having no breastfeeding problems played a greater role in the success of exclusive breastfeeding [97]. Whether a short stay of less than 48 hours might also have had a negative effect on breastfeeding success was not further tested.

Fitzsimons and Vera-Hernández analyzed data from the Millennium Cohort Study and the Maternity Users Survey in the UK and demonstrated that the day a baby was born was critical for breastfeeding success [115]. Low-educated mothers of infants born vaginally just before or at the weekend were less likely to be satisfied with the infant feeding advice they received in the hospital and were less likely to breastfeed their infant for at least 90 days compared to low-educated mothers who delivered vaginally on Mondays. Because there were no notable differences regarding the length of stay in the hospital and maternal and infant characteristics, the results indicated that there was less breastfeeding support in hospitals on weekends, which may be due to staff duties being limited to core tasks, since staff working hours are more expensive on weekends [115]. However, since this result did not apply to high-educated mothers, who, e.g., might more likely seek out for help and may benefit more from the same level of support due to having more information beforehand [115], it remains open whether this hospital factor would have had an impact on breastfeeding rates in SuSe II, a study collective consisting predominantly of high-educated mothers. In addition, the perinatal health care system may differ between the UK and Germany.

5.3.1.2 Supplemental Feeding

Looking at breastfeeding rates at discharge (5 days in SuSe I vs. 3 days in SuSe II according to the SuSe mothers), it is striking that the share of mothers who had breastfed their infant and additionally fed infant formula (Zwiemilch) was almost twice as high in SuSe II than in SuSe I (17% vs. 8%), although hospitals in SuSe II had more

frequently reported that additional feeding was only provided if medically indicated (70.6% vs. 58.9%) (Step 6) [96]. At the same time, breastfeeding mothers in SuSe II less often reported that their infant had received supplemental feeding, including sugar solutions and tea, in the first 3 days pp during hospital stay compared to mothers in SuSe I (23.3% vs. 56.0%) [16,19]. With the higher number of certified Baby-Friendly hospitals (25.7% vs. 1.3%) and the improved implementation of the 10 Steps as well as the high number of lactation consultants (91.7% vs. 15.1%) in SuSe II compared to SuSe I [96], this result may be surprising, since early formula supplementation is associated with an increased risk for breastfeeding difficulties [112] and of not fully breastfeeding in the following months after birth as well as early breastfeeding cessation [116]. Maternal reasons frequently cited for in-hospital formula supplementation of healthy term newborns include perceived insufficient milk supply (e.g., no milk let in yet; baby seems frequently hungry), signs of inadequate intake (e.g., excess weight loss), and poor infant breastfeeding behavior (e.g., baby too sleepy) [116] – reasons that are partly considered as not being medically acceptable, but at the same time point to the need for proactive and improved maternal information and support by health care professionals [112,117].

However, because lactogenesis II, the begin of copious milk secretion, often collides with the timing of discharge [96,118], early formula supplementation might be chosen in some cases, giving mothers a sense of security when they are not informed about this process or have unrealistic expectations about infant behavior [119], and indicating insufficient support from health care professionals before and when problems arise [112].

Although in both SuSe studies, supplemental feeding was predominantly provided to breastfed infants only if medically indicated, maternal request for supplemental feeding of infant formula was considered in 70.2% (SuSe I) and 72.5% (SuSe II) of the maternity hospitals, respectively [16,19]. This maternal request, e.g., due to maternal concerns about insufficient milk supply as a prominent reason for in-hospital supplementation [116] together with time constraints and a lack of understanding of the potential longer-term effects of early supplemental feeding of infant formula among the hospital staff [120,121] during a concurrent short hospital stay may explain the higher rate of Zwiemilch feeding at discharge in SuSe II compared with SuSe I.

In fact, data from the Austrian SUKI study collected in 2019, including 1,214 mothers, demonstrated that half of the infants already received formula within the first three days of life [102].

However, as non-exposure to Step 6 is associated with shorter breastfeeding duration [122,123] and this step is reported to be a key step for breastfeeding success [124], hospitals should pay increased attention to non-clinically indicated early supplemental feeding and its associated factors [121].

5.3.1.3 Alternative Feeding Methods

According to the S2k guideline "Care of newborns in the maternity hospital" of the Association of the Scientific Medical Societies in Germany (AWMF) and the Clinical Protocol #3: “Supplemental Feedings in the Healthy Term Breastfed Neonate, Revised 2017” of The Academy of Breastfeeding Medicine, the expressed milk from the infant’s own mother should be fed whenever possible, if there is a medical indication for supplementary feeding [125,126]. Feeding methods such as cups, spoons or feeding bottles and teats can be used for term infants during their stay at the maternity facility, according to the WHO (recommended, moderate-quality of evidence) [59]. If the infant is able to latch onto the breast, supplemental feeding should be given as a complement directly following the breastfeeding episode [126], to maintain the infant's breastfeeding ability and to maximize maternal breast stimulation [30]. Supplemental nursing systems offer the advantage that the infant is at the breast while the supplement is fed [30]. Of 2,308 internationally surveyed English-speaking International Board Certified Lactation Consultants (IBCLCs), the majority believed that this feeding method best preserved the breastfeeding relationship [127]. In the case of delayed lactogenesis II, e.g., only a short period of supplementary feeding may be required [30]. If the mother is properly guided, and milk removal is ensured, she may return to exclusive breastfeeding whenever possible [112].

Although the WHO states that the avoidance of feeding bottles and teats in the first 5 days pp make little or no difference on breastfeeding outcomes among term infants [59], mothers and other family members should still receive appropriate guidance and counseling on the use or avoidance of bottles and teats for term infants until breastfeeding is successfully establishment, as there are a number of reasons for caution about their use [58].

For example, bottle feeding could lead to breastfeeding difficulties, because the physiology of suckling on a feeding bottle is different from suckling at the breast [58]. In this context, the term "nipple confusion" is often used to refer to an infant's difficulty with one feeding technique or preference for one feeding technique over another after the exposure to an artificial nipple [128]. Although an analysis of 14 articles revealed evidence of nipple confusion associated with the use of bottle feeding, this term remains controversial, because it could not be determined whether an infant refuses the breast and prefers the bottle because it already has breastfeeding difficulties or whether this is due to nipple confusion [128]. According to the IBCLCs surveyed, bottle feeding preserves the breastfeeding relationship the least, but at the same time, the bottle was the most frequently used supplemental feeding method in this survey, since the decision about the supplementation method was mostly determined by the mother [127].

The use of alternative feeding methods such as cup or spoon feeding in the hospital setting increased in SuSe II compared to SuSe I (51.4% vs. 9.7%, respectively) [96]. Mothers participating in SuSe II who gave birth in maternity hospitals that used alternative feeding methods had higher odds of exclusive breastfeeding during their hospital stay (OR [95% CI]: 1.91 [1.34–2.74]) and at the time of discharge from the hospital (OR [95% CI]: 1.54 [1.07–2.24]) compared to mothers who gave birth in maternity hospitals that used bottles [97], suggesting that these hospitals were likely to have critically addressed the issue of supplemental feeding. The guided use of alternative feeding methods may have helped mothers in SuSe II to overcome early breastfeeding difficulties that led to supplemental feeding. This may be one explanation why fewer mothers in SuSe II ceased breastfeeding early compared to mothers in SuSe I.

5.3.1.4 Pacifier and Nipple Shields

The use of a pacifier during the first 2 weeks pp was one of the factors in SuSe II that was negatively associated with exclusive breastfeeding at each of the five time points studied. Mothers who did not use a pacifier during the first 2 weeks pp had higher odds of exclusive breastfeeding at the hospital (OR [95% CI]: 1.63 [1.11–2.40]), at discharge (OR [95% CI]: 2.22 [1.46–3.37]), 2 weeks pp (OR [95% CI]: 2.60 [1.71–3.93]), 2 months pp (OR [95% CI]: 2.20 [1.48–3.25]), and 4 months pp (OR [95% CI]: 2.07 [1.46–2.92]) compared to mothers who used a pacifier during the first 2 weeks pp [97].

The early use of nipple shields was negatively associated with exclusive breastfeeding at three of the five time points. Mothers who did not use nipple shields during the first 2 weeks pp had higher odds of exclusive breastfeeding at the hospital (OR [95% CI]: 1.75 [1.24–2.47]), 2 months pp (OR [95% CI]: 1.51 [1.06–2.15]), and 4 months pp (OR [95% CI]: 1.83 [1.33–2.52]) compared to mothers who used nipple shields during the first 2 weeks pp [97]. Pacifiers were used by 70.1% and nipple shields by 36.2% of participating mothers [97]. In SuSe I, they were used by about the same proportion of mothers (73.5% and 31.0%) [16].

Although the WHO recommendation (Step 9) was changed from a complete prohibition of artificial teats and pacifier due to the lack of evidence of negative effects on breastfeeding rates in healthy term infants to counseling mothers on their use [58], studies other than SuSe II reported negative effects on breastfeeding outcomes as well [123,129–132]. These studies were not included in the analysis by the WHO due to their publication date and/or study design (e.g., observational studies, systematic review and meta-analysis not following the procedures of the Cochrane handbook for systematic reviews of interventions) [59].

Nipple shields are used, e.g., when mothers experience pain during breastfeeding or have problems with latching [130,133]. Their use can help mothers to overcome early breastfeeding difficulties, but can also lead to dependence [130]. The concern, the use of nipple shields could lead to reduced milk transfer was not confirmed by more recent studies [134,135]. Mothers who had used nipple shields and were attended during their pregnancies by health care professionals who had recently undergone a process-oriented training program on breastfeeding support did not breastfeed for a shorter duration compared to mothers who had not used nipple shields, whereas mothers whose health care professionals had not received training breastfed for a shorter duration if they had used nipple shields [133].

This finding underlines the need of health care professionals being aware of the importance of counseling mothers on the use of nipple shields and underlying problems in order to prevent inappropriate use [130,135].

Although in SuSe II no data were collected on the precise time when the nipple shields were introduced, since this usually occurs shortly after the initiation of breastfeeding [130], the results suggest that the educational needs of mothers with regard to the appropriate use of nipple shields could be better addressed by health care professionals in the hospital setting.

The use of pacifiers in the hospital may be indicated by certain medical conditions of the infant such as a low birth weight (< 1,500 g) and the inability of the child to suckle at the breast, the need of early oral stimulation to develop and maintain the suckling reflex, or severe maternal illness or medication [136]. Several of these reasons should not have applied to the mother-infant pairs in the SuSe studies due to its study design. For full term infants, pacifiers should only be given once breastfeeding is established (~3–4 weeks pp) and should only be used to soothe a breastfed infant when it is not hungry and/or when putting down to sleep [136,137]. If pacifiers replace suckling and thus the breast is stimulated less frequently by the infant, this may result in lower maternal milk production. In addition, there is a risk that a mother may overlook an infant's early feeding cues, such as smacking of the lips, thereby delaying breastfeeding until the infant begins to cry [58].

Pacifier use, along with other factors such as breastfeeding on demand, a supine position for sleeping, and no overheating, is associated with a lower risk of sudden infant death syndrome (SIDS) [137–139]. Fortunately, cases of SIDS are steadily declining in Germany (with 84 infants under 1 year of age who died in 2020) [140]. However, since pacifier use could have a negative effect on breastfeeding outcomes and breastfeeding itself is a protective factor for SIDS, pacifier use should follow a benefit-risk approach based on the trade-off between SIDS and pacifier-related breastfeeding outcomes, according to the results of the systematic review and meta-analysis by Buccini et al. [131].

Since a high proportion of SuSe II mothers already used pacifiers within the first 14 days pp and this was shown to be a risk factor for exclusive breastfeeding cessation [97], families should be counseled more about this hazard and techniques should be taught to soothe an infant without offering a pacifier [131].

5.3.1.5 Initiation of Breastfeeding and Mode of Delivery

The initiation of breastfeeding within the first hour of life (Step 4) was enabled less often in the SuSe II hospital collective than in SuSe I (52.3% vs. 93.7%). At the same time, the median proportion of deliveries by Cesarean section was twice as high as in SuSe II (30.0% vs. 15.0%) [96]. In Germany as well as in other countries, the rates of deliveries by Cesarean section have increased in recent decades [110,141]. Underlying reasons include, e.g., an increase in the number of older pregnant women and the prevalence of obesity, as well as organizational, economic, and social factors [142]. A Cesarean section can be a life-saving intervention when medically indicated, but each delivery by Cesarean section is also associated with health risks for mother and infant [143]. In addition, deliveries by Cesarean section are described to complicate and delay early breastfeeding initiation [144–147]. In the SuSe II hospital collective, the initiation of breastfeeding within the first hour of life was also less likely to be enabled after a delivery by Cesarean section compared to a vaginal delivery (54.1% vs. 71.6%) [20]. Mothers who gave birth in hospitals that implemented Step 4 for both types of delivery had higher odds of exclusive breastfeeding throughout the first 2 weeks pp (OR [95% CI]: at hospital: 1.46 [1.04–2.05]; at discharge: 1.83 [1.29–2.59]; 2 weeks pp: 1.43 [1.01–2.02]). At the same time, mothers who delivered vaginally had higher odds of exclusive breastfeeding at four time points of the study period (OR [95% CI]: at discharge: 1.76 [1.24–2.49]; 2 weeks pp: 1.55 [1.09–2.20]; 2 months pp: 1.54 [1.08–2.20]; 4 months pp: 1.51 [1.09–2.11]) compared to mothers who delivered their infant by Cesarean section [97]. The fact that a Cesarean section can, in turn, shorten the duration of exclusive breastfeeding has also been described in a literature review by Li et al. (2021) analyzing 18 studies (including 13 quantitative and five qualitative studies) from various countries such as China, Canada, Turkey, UK, Italy and South Africa [148].

As early initiation of breastfeeding is a core indicator for monitoring breastfeeding worldwide [149], and the poorer implementation in SuSe II compared to SuSe I cannot be attributed solely to the higher rate of Cesarean sections, this parameter could be used within the framework of the German National Strategy for the Promotion of Breastfeeding through its collection via the mandatory quality assurance procedures

in maternal-fetal and neonatal medicine covering all hospital births in Germany [90] in order to improve its implementation in a resource-efficient and effective way.

In addition, health care professionals should be aware of providing additional breastfeeding support to mothers with other intrapartum interventions, such as opioid pain medication, that have also been described to delay the initiation of breastfeeding [144].

Furthermore, interventions involving health care professionals, such as audits and feedbacks as well as antenatal counseling in the hospital, may reduce the rate of Cesarean sections [150,151].

5.3.1.6 Early Breastfeeding Problems

Several risk factors for breastfeeding difficulties can be detected at an early stage in the hospital setting and should always be taken seriously. These include prenatal factors such as the presence of maternal obesity (BMI ≥ 30) or primiparity, intrapartum factors such as the use of medication during labor, infant factors such as ineffective or unsustained suckling, and maternal factors such as sore nipples [112]. Other known risk factors have already been discussed above (short hospital stay, supplemental feeding of infant formula, pacifier use, need for breastfeeding aids) [112].

In both SuSe studies, about half of the mothers (40.3% in SuSe I vs. 52.3% in SuSe II) willing to breastfeed reported breastfeeding problems during the first 2 weeks pp [20]. Mothers with early breastfeeding problems had lower odds of exclusive breastfeeding during the first 2 months of life in SuSe II [97] and higher odds of a short breastfeeding duration (< 4 months) in SuSe I [16]. Although the most commonly reported breastfeeding problem by mothers was the same in both studies (sore nipples), the prevalence was notably different (60.9% in SuSe II vs. 33.9% in SuSe I). Also, noticeably more mothers in SuSe II reported that their infant had difficulties drinking and swallowing (44.4% in SuSe II vs. 17.6% in SuSe I) and insufficient milk supply (32.7% in SuSe II and 18.3% in SuSe I) (multiple answers possible) [16,19].

In a retrospective study conducted in the UK with data from 565 mothers collected in 2017–2018, sore nipples, latching difficulties, and the impression of not having enough milk were also commonly cited breastfeeding problems [152].

In a cross-sectional study from Denmark with data from 2014, these breastfeeding problems were described to be the three most challenging for the 1,437 participating mothers [153]. However, not all breastfeeding problems appear to be equally associated with the risk of (exclusive) breastfeeding cessation: mothers with latching difficulties and/or those with the impression of not producing enough milk seem to be at a higher risk of breastfeeding cessation than mothers who report having too much milk, blocked ducts, or sore nipples [152]. Nevertheless, breastfeeding problems can lead to a large proportion of mothers not reaching their desired breastfeeding duration [154].

It is unclear why such striking differences in the prevalence of specific breastfeeding problems were found in the two SuSe studies. Perhaps this is due to the different study populations per se, changes in mothers' expectations over the years, or because more potential risk factors for breastfeeding difficulties applied to SuSe II mothers, such as an older age, the higher number of deliveries by Caesarean section, and the shorter hospital stay. However, mothers in SuSe II may have benefited from regular staff training, which was practiced more frequently in SuSe II hospitals compared to SuSe I hospitals (47.7% vs. 24.0%), to successfully manage breastfeeding problems [96]. According to the systematic review and meta-analysis by Wang et al. published in 2023, breastfeeding training programs improve breastfeeding-related knowledge, skills, and attitudes of health care professionals and positively impact breastfeeding outcomes, such as fewer mothers having breastfeeding problems, fewer infants receiving breastmilk substitutions in the first week of life without medical indication, and longer durations of exclusive breastfeeding [155].

However, because breastfeeding problems are common [152,153,156] and have been shown to be a risk factor for non-exclusive breastfeeding and breastfeeding cessation in SuSe and other studies [95,152,156], there is still the need in the hospital setting to 1) prevent potential problems, 2) identify them early, and 3) provide ongoing, tailored, and emotional support to mothers, especially in early discharge settings [153,156–158].

5.3.1.7 Antenatal Breastfeeding Information and Ongoing Support

Hospitals are supposed to inform pregnant women about the health benefits and practice of breastfeeding already before delivery [58,83].

Because the response mode for this recommendation (Step 3) was changed from multiple answers in SuSe I to a single one in SuSe II to reduce the probability of a socially desired answer, the results of the two SuSe studies cannot be compared directly with each other.

Prenatal interventions to improve breastfeeding outcomes are described as effective when they combine education and interpersonal support and when the family or partner is involved [159]. Unexpectedly, mothers in SuSe II who gave birth in hospitals that provided prenatal written breastfeeding information had consistently lower odds of exclusive breastfeeding at 2 weeks pp (OR [95% CI]: 0.70 [0.50–0.98]), 2 months pp (OR [95% CI]: 0.68 [0.48–0.97]), and 4 months pp (OR [95% CI]: 0.73 [0.53–0.99]) compared to mothers from hospitals that were not fully compliant [97].

Unfortunately, the hospital questionnaire did not indicate whether educational material was combined with interpersonal support and whether family members or partners were addressed as well [16,19]. A descriptive survey conducted in Malaysia in 2015 on women's perceptions of antenatal breastfeeding education found that almost all mothers (99%) perceived the prenatal information as useful, but often wished to get more information on specific topics such as milk expression and overcoming low milk supply [160]. It can only be speculated that the prenatal information provided for mothers in SuSe II may have been insufficient and that the prenatal information settings addressed by the hospitals might have focused on the upcoming delivery rather than on breastfeeding.

According to a systematic review by Skouteris et al., in which twelve studies were analyzed, the most successful interventions to improve breastfeeding outcomes in high-income countries were conducted in the pp period and over a longer period of time [161]. Thus, hospitals are advised to coordinate discharge so that parents and their infants have access to ongoing support (Step 10), such as by referring mothers to breastfeeding support groups in the community [58,83]. In the two SuSe studies, this step (referring mothers to breastfeeding support groups) was practiced by an approximately similar proportion of hospitals (~60%) [96].

While the WHO rated the quality of evidence for the linkage to continuing support at discharge on breastfeeding outcomes as low [59], Pérez-Escamilla et al. published a systematic review concluding that community support (Step 10) is important in maintaining breastfeeding success [124].

Breastfeeding support groups are valued by mothers, because they combine professional and peer group support [162]. In SuSe II, Step 10 had no significant effect on exclusive breastfeeding in the multivariable binary logistic regression model [97]. Since effective postnatal support is described as tailored ongoing visits by trained personnel that allow women to predict when support is available [158] and mothers in Germany already have assured follow-up care independent of the maternity hospital through the legally guaranteed midwifery assistance [70], it may not have been possible to demonstrate an effect of Step 10, or this step might not be as important in Germany.

Nevertheless, the results of SuSe II regarding the presence and effect of breastfeeding problems indicate, that the quality of follow-up care needs to be improved. Broad-based support services to which mothers are referred at the time of discharge should help them find the support that fits their needs at the right time [163].

5.3.1.8 Ten Steps to Successful Breastfeeding

Taken together, hospitals in SuSe II implemented 7 of the 10 Steps to a greater extent than hospitals in SuSe I (Steps 1, 2, 5, 6, 7, 8, and 9) [96]. The results for Steps 3 and 4 cannot be compared one-to-one, because the response options were modified: change in response mode from multiple answers to a single one (Step 3) and from a single answer for both types of deliveries to a differentiation by mode of delivery (Step 4) [96]. Reasons for the improved implementation of most steps may include the significantly higher proportion of certified hospitals (25.7% vs. 1.3%) [96], which also increased in parallel across Germany [164], as well as the significantly higher proportion of academic teaching hospitals in SuSe II (62.4% vs. 20.6%), which, according to the literature, implement more steps than non-teaching hospitals [165].

The greater implementation of the 10 Steps in SuSe II is also reflected in the achievement of the BPI. While in SuSe I, hospitals implemented a median of 5 Steps ($P_{25} = 4$; $P_{75} = 6$) [18], hospitals in SuSe II implemented a median of 7 Steps ($P_{25} = 5$; $P_{75} = 8$) [97]. A high BPI in SuSe II was significantly associated with exclusive breastfeeding

success, i.e., mothers who were exposed to ≥ 9 Steps had higher odds of exclusive breastfeeding during their hospital stay (OR [95% CI]: 3.86 [2.34–6.37]) and at the time of discharge (OR [95% CI]: 2.06 [1.27–3.35]) compared to mothers who were exposed to ≤ 5 Steps [97]. While no association was shown for continued exclusive breastfeeding success in SuSe II (≥ 14 days pp), a systematic review published in 2016 including 58 studies conducted in 19 different countries demonstrated a positive association between the number of steps implemented and the likelihood of improved breastfeeding outcomes in the short- as well as in the long-term [124].

An additional analysis of the SuSe II study showed, that most of the mothers who gave birth in a hospital with a high BPI, stayed in a BFHI-certified facility (95.5%). Recent studies that compared breastfeeding rates of mothers from BFHI-certified and non-certified facilities, did not find convincing longer-term associations between in-hospital breastfeeding promotion and maternal exclusive breastfeeding success, similar to our study [123,166,167]. For example, in the Swiss study by Spaeth et al. published in 2018, the adjusted rate of exclusive breastfeeding at 3 months was 52.2 (95% CI [47.6–56.9]) for babies born in current certified facilities and 51.2 (95% CI [45.8–56.5]) for babies born in never certified facilities (adjusted for, e.g., maternal age, parity, parental education) [166], and in the Belgian study by Robert et al. published in 2019, the proportion of children exclusively breastfed at 5 months pp was 16.8% in children born in certified facilities compared to 15.8% in children born in non-certified facilities ($p = 1.0$), while the parental sociodemographic, birth, and breastfeeding characteristics did not differ significantly between those two groups [167]. Perhaps it is the cultural context of mother-child care that explains why these differences between the worldwide evaluation and the single studies from high-income-countries were observed [168].

The results of SuSe II further showed that even being exposed to a medium BPI (6–8 Steps) compared to a low BPI (≤ 5 Steps) was insufficient to independently support exclusive breastfeeding in participating mothers (at the hospital OR [95% CI]: 1.05 [0.73–1.49]), at discharge OR [95% CI]: 1.06 [0.73–1.56]) [97].

There were no BFHI-certified hospitals among those with a low and medium BPI. Therefore, it is not possible to assess whether the implementation of the measures in the non-certified hospitals was monitored. Two studies examining maternal perceptions of hospital adherence to the 10 Steps in certified and non-certified facilities concluded that, with the exception of Step 9 in both studies and Step 6 in one of the two studies, there were no differences in mothers' reported adherence according to the BFHI status [123,166].

The implementation of the steps and the level of support for mother also depends on the commitment and personal attitudes of health care professionals and other framework conditions in the hospitals [120]. A study from the U.S. used qualitative interviews to identify perceived barriers and facilitators to progress on the 10 Steps [169]. Barriers perceived included, e.g., interference in mothers' decisions, lack of staff self-efficacy, nighttime practices by staff, too many visitors during labor and delivery, increasing cesarean section rates, and the need for pacifiers. Facilitators perceived included, e.g., hands-on training, strong management support for the 10 Steps, and seeing mothers utilizing breastfeeding services [169]. In addition, according to a study of health care professionals' perceptions of implementing the BFHI, some steps appear to be easier to implement than others, such as Step 4 (skin-to-skin contact), because its implementation is not time-consuming for staff, or Step 7 (24h rooming-in), because the structures were already in place [120]. Although no qualitative results emerge from SuSe II, Step 5 (breastfeeding instruction and documentation), Step 7 (24h rooming-in), and Step 8 (breastfeeding on demand) were the best implemented steps in SuSe II [96]. That these steps can be practiced relatively well has also been observed in other studies from the U.S. [165] and Switzerland [166].

Despite the generally better implementation of the steps in SuSe II compared to SuSe I, there is still a need for further improvement in breastfeeding promotion in hospitals at the structural level, such as the existence of a breastfeeding policy and a coordinator (Step 1) or regular staff training (Step 2), and at the practical level, such as the provision of antenatal breastfeeding information (Step 3) and enabling early breastfeeding initiation (Step 4) [96]. Not only should these steps be implemented in more hospitals so that all mothers are exposed to a high level of breastfeeding support, but the quality of implementation must also be ensured.

5.3.2 Breastfeeding Support in the Home Environment

After the short pp hospital stay, mothers usually rely on further breastfeeding support, as breastfeeding still needs to become established. In order to look for other possible explanations for the improved breastfeeding practices in the maternal collective in SuSe II compared to SuSe I, support factors for breastfeeding in the mothers' home environment are considered. In addition, further approaches to support mothers are discussed.

5.3.2.1 Midwife Support

In Germany, mothers are entitled to pp support by a midwife who can assist them with problems and questions during the first 12 weeks after birth and beyond, if needed [70]. In both SuSe studies, mothers most frequently stated that midwives were most helpful to them in dealing with difficulties (SuSe I) or questions (SuSe II) about breastfeeding after hospital discharge (67.6% vs. 80.3%). Only a small proportion of mothers reported coping with breastfeeding problems alone (7.4% in SuSe I vs. 2.7% in SuSe II). The hospital or maternity ward and physicians played a secondary role as the most important advisors for mothers in both studies [16,19]. Because mothers in SuSe II had an approximately two day shorter hospital stay after delivery compared to mothers in SuSe I [96], the importance of follow-up care by midwives for early breastfeeding issues may have increased in the maternal collective of SuSe II.

Ongoing scheduled visits by trained health professionals, tailored to the needs and the setting of mothers, are effective to support breastfeeding and can be combined with peer/lay support [158,170]. In a local cohort study from Freiburg, Germany, the lack of pp care by a midwife was an independent negative factor for the duration of breastfeeding (OR [95% CI]: 0.31 [0.12–0.79]) [171]. Since midwives are also important interlocutors when it comes to breastfeeding difficulties [172] and a higher proportion of mothers in SuSe II had reported midwives as their main source of help [16,19], this may have contributed to the higher breastfeeding rates in SuSe II compared to SuSe I.

5.3.2.2 Partner Support

The partner plays an important role in supporting the mother and can thus contribute to breastfeeding success or failure [95,173]. In the SuSe studies, 70.6% and 90.1% of the mothers were supported by their partners in daily chores during the first 14 days pp in SuSe I and SuSe II, respectively. In parallel, the share of mothers who reported receiving no support was about twice as high in SuSe I compared to SuSe II (11.5% vs. 5.1%) [16,19]. One reason for the increased support could be the modification of parental allowance in 2007, which was intended to make it easier for parents to share child care. Before its introduction, the so-called "Erziehungsgeld" was only granted to one person at a time [77] and the share of fathers was only 3% [174]. The share of fathers receiving parental allowance has steadily increased since its introduction, from 21% in 2008 to 44% in 2019 [174,175]. Although most fathers, e.g., among children born in 2019, received parental allowance for a short period of up to 2 months (76%), 50% of them claimed the benefits immediately after birth [175].

In both SuSe studies, almost 90% of partners had a positive attitude towards breastfeeding and perceived it to be important [16,19]. SuSe II mothers whose partners had a positive attitude towards breastfeeding had higher odds of exclusive breastfeeding at two points in time (at discharge (OR [95% CI]: 1.87 [1.10–3.18]) and 2 weeks pp (OR [95% CI]: 1.99 [1.14–3.46])), compared to mothers whose partners were not concerned with infant feeding, whose attitudes were unknown, or who did not want the mother to breastfeed [97]. A negative attitude of the partner was the main risk factor for not initiating breastfeeding in a multivariate logistic regression analysis (OR [95% CI]: 21.79 [13.46–35.27]) and was also negatively associated, although to a lesser extent, with breastfeeding duration up to 4 months (OR [95% CI]: 1.62 [1.25–2.08]) in a German cohort study from Bavaria [95].

In order to achieve effective breastfeeding support of partners, partners should also be involved and supported with breastfeeding information by health care professionals [176,177]. They can be informed, e.g., about the health benefits of breastfeeding, the learning process of breastfeeding, new challenges such as lack of sleep and exhaustion, learn how to support the mother, and how to engage with their baby [177].

Analyzing two studies using cross-sectional surveys on the relationship between partner-reported breastfeeding support and mother's perception of received support on breastfeeding outcomes, Rempel et al. concluded that only responsive behaviors sensitive to the mothers' needs consistently predicted longer breastfeeding duration [173]. Whereas a more appreciative, knowledgeable, and present breastfeeding influence behavior of the partner was associated with lower breastfeeding intentions and durations among mothers. The authors discuss that these behaviors could potentially undermine the sense of self-efficacy, autonomy, and control of a mother [173]. In an integrative review published by Davidson & Ollerton in 2020, evaluating eight studies (incl. Rempel et al., 2017 [173]), the authors concluded that partner support provided as part of a breastfeeding team in a responsive manner promotes the mother's self-efficacy and sense of autonomy, and thus breastfeeding outcomes in Western culture settings [178]. Based on these findings, well-informed partners should sensitively align their capabilities to the needs of the mother in order to provide her with the best possible support she needs.

5.3.2.3 Social Support Network

In dealing with difficulties (SuSe I) or questions (SuSe II) about breastfeeding after hospital discharge family/acquaintances/friends played a greater role in SuSe I than in SuSe II (18.1% vs. 7.8%). However, the importance of family and friends as a source of information on infant feeding increased during the 1st year of life in both studies [16,19].

Family and friends as well as mothers with breastfeeding experience can act as peer supporters. Peer supporters may be trained or untrained and could provide additional support or an alternative form of support when professional support is not available [170] or perceived as inadequate [179]. Peer supporters are valued by mothers for spending time with them, sharing experiences, and being caring, providing realistic information, as well as practical and emotional support [180]. For example, first time mothers who received proactive phone-based breastfeeding support up to 6 months pp from trained mothers with breastfeeding experience in addition to usual care, which consisted of access to hospital specialist breastfeeding services, the offer of one to two postnatal visits at home from a hospital midwife, as well as community and telephone helpline services, were more likely to breastfeed 6 months pp compared

to mothers who had access to usual care only (intervention 75%, usual care 69%; RR [95% CI]: 1.10. [1.02–1.18] adjusted for breastfeeding intention, formula given (prior to recruitment) and site) [181].

Peer support appears to be a helpful component for maintaining breastfeeding in settings with high breastfeeding initiation rates [181] and therefore could be an important breastfeeding promotion component for Germany as well.

On the other hand, in a study from the UK, it was shown that mothers who received family support from their partner and their own mother and less support from health care professionals were less likely to breastfeed at 2 months compared to mothers who received extensive support from a wide range of supporters (health care professionals, friends, partner, own mother) (13% vs. 94%) [182]. Mothers receiving family support had a high probability of infant feeding by family, while mothers with extensive support reported little infant feeding by others. The maternal sample of this study consisted of mothers who all had initiated breastfeeding and were predominantly in a high socioeconomic position [182], similar to those in the SuSe studies.

This finding highlights both the complexity of family support in relation to breastfeeding and the potential value of extensive support from health care professionals and a mothers' social network [182]. Although no further direct conclusions can be drawn from the SuSe studies, this complexity may have contributed to the different breastfeeding rates in SuSe I and II.

For mothers who lack an adequate breastfeeding social support network or who prefer online support to offline support, online breastfeeding peer support could be another valuable option [179]. In an integrative review from 2021 on mothers' experiences of online breastfeeding peer support, which evaluated 14 heterogeneous studies in terms of the composition of the breastfeeding support groups (healthcare professionals present/not present, peer with/without education, no information on the administration or moderators of the groups), the authors concluded that online breastfeeding peer support provides some positive effects on exclusive breastfeeding rates and breastfeeding duration through maternal empowerment [179]. Nevertheless, in order to provide a safe space for mothers where information is accurately communicated, it is important that these groups are moderated [183].

5.3.3 Individual Determinants of Breastfeeding Success

Besides breastfeeding support in the hospital and the potential impact of the environment at home, there are a number of individual maternal determinants of breastfeeding success [8,9]. Determinants that were of significance in SuSe II are discussed in this section, with the exception of smoking, a factor described to be strongly associated with breastfeeding initiation and continuation that requires targeted support [184].

5.3.3.1 Breastfeeding Experience and Parity

Maternal breastfeeding experience was one of the two factors independently associated with exclusive breastfeeding in SuSe II at all time points: at hospital (OR [95% CI]: 1.63 [1.16–2.30]), at discharge (OR [95% CI]: 1.92 [1.34–2.75]), 2 weeks pp (OR [95% CI]: 1.77 [1.24–2.52]), 2 months pp (OR [95% CI]: 2.19 [1.54–3.13]), and 4 months pp (OR [95% CI]: 1.82 [1.33–2.51]).The reference group of mothers without previous breastfeeding experience included both multiparous women who had not breastfed their previous child as well as first-time mothers [97].

Previous breastfeeding experience has been shown to be a protective factor for subsequent breastfeeding initiation [95,185], exclusive breastfeeding [186], and breastfeeding duration [185]. Maternal breastfeeding experiences affect breastfeeding attitude and self-efficacy, characteristics that could help mothers to achieve breastfeeding recommendations [186–189]. However, an unsatisfactory or negative previous breastfeeding experience as well as a short previous breastfeeding duration has been shown to have a negative impact on subsequent breastfeeding [171,185]. In addition, studies reported that multiparous women often chose the same feeding method for each of their infants [190] and generally repeated [191], but sometimes also reduced the duration of exclusive/any breastfeeding with their current infant [192]. Compared to multiparous women, first-time mothers are more likely to initiate breastfeeding later, more likely to suffer from breastfeeding problems and more likely to give infant formula at the time of hospital discharge [193], and thus are more likely to be exposed to factors negatively associated with breastfeeding outcomes [97,116,152,156].

Overall, it would be beneficial if prenatal and postnatal breastfeeding support include tailored interventions and information for mothers based to their parity and breastfeeding experiences to improve breastfeeding outcomes [185,193].

Mothers without breastfeeding experience and mothers who breastfed their previous child/ren for only a short time could be provided with greater support in order to improve breastfeeding attitude and self-efficacy and therefore breastfeeding outcomes [187,192]. Multiparous women who have previously breastfed for a longer duration could be encouraged to meet or exceed this duration with a subsequent child [192].

5.3.3.2 Breastfeeding Duration Intention

SuSe II mothers who tried to breastfeed but did not have a specific idea about the duration of full breastfeeding before delivery or were insecure if breastfeeding would work had lower odds of exclusive breastfeeding from discharge until 4 months pp compared to mothers who had a concrete idea (to breastfeed fully for at least up to 4 months) (at discharge (OR [95% CI]: 0.30 [0.19–0.49]); 2 weeks pp (OR [95% CI]: 0.17 [0.10–0.28]); 2 months pp (OR [95% CI]: 0.22 [0.13–0.37]); 4 months pp (OR [95% CI]: 0.23 [0.13–0.40])) [97].

The intention to breastfeed in general and for a longer duration can have a beneficial effect on breastfeeding success [129] and satisfaction with breastfeeding after birth [194]. Only 11% of the participating mothers in SuSe II did not have a specific idea about the duration of breastfeeding or were insecure [97], which may be due to the high level of education and older age of the sample–characteristics that are associated with higher odds of breastfeeding intention in general [195]. In a Canadian study involving 401 pregnant women, the planned length of exclusive breastfeeding was one predictor of breastfeeding self-efficacy [188]. As mentioned above, breastfeeding self-efficacy in turn was found to be associated with better breastfeeding outcomes as it reflects a mother's confidence in breastfeeding [189,196]. Breastfeeding self-efficacy is a modifiable factor that can ideally be improved by combining prenatal and postnatal interventions [196]. Besides improving maternal breastfeeding self-efficacy, prenatal breastfeeding education can also improve maternal attitudes towards breastfeeding and breastfeeding knowledge [197,198], thereby increasing the odds of exclusive breastfeeding [198].

The finding that SuSe II mothers who had a concrete idea about the duration of full breastfeeding before delivery had higher odds of exclusive breastfeeding is not surprising, assuming that other confounding factors, such as those described above, are related to this intention (and may also affect breastfeeding success).

5.3.3.3 Pacifier use

Although possible benefits and risks of pacifier use have already been discussed in the hospital setting, since a high proportion of SuSe mothers had given their infant a pacifier in the first 2 weeks pp, the mothers' view of its use will be presented in the following as described in the literature.

In a qualitative study from the U.S. published by Rocha et al. in 2020, which analyzed data from 23 mothers of healthy, term newborns regarding their thoughts and experiences about pacifier use, the authors concluded that many mothers had a positive attitude towards pacifiers, because the use was beneficial for the maternal-infant experience (comfort for child, soothing, calming); however, there were also mothers who expressed concerns about short-term (nipple confusion) and long-term (reliance, dental health) pacifier use [199]. In addition, based on their own experiences, some mothers also expressed concerns about the advice given by health care professionals on the use of pacifiers [199].

The results of an Australian study published in 2012 by Mauch et al., including data from 670 first-time mothers, of which 79% introduced pacifier, confirmed the mentioned benefits of pacifier use by mothers in the qualitative study with quantitative data on reasons for pacifier use [132]. In both studies, SIDS risk reduction was cited by only few mothers as a reason for using or benefiting from pacifiers, while family members influenced mothers in favor of pacifier use [132,199]. In most cases, mothers indicated that no one had advised them to use pacifiers (30.6%), followed by the advice of the mother / mother-in-law (28.7%) and the midwife (22.7%) [132].

Ultimately, the benefits of pacifiers appear to be high for many mothers in their interactions with their infant, as shown by the high proportion of mothers that offered their infant a pacifier [16,97,132]. However, the results of the studies discussed raise the question of whether education in the hospital setting would be sufficient if the goal was to get more mothers to avoid using pacifiers before breastfeeding is established, or whether this would require a general change in thinking including a mother’s broader support network and the mother herself.

5.3.3.4 Breastfeeding Problems

In order to understand how mothers with breastfeeding problems perceive their situation and to identify their coping strategies, Spannhake et al. conducted a qualitative survey of 15 mothers in Germany in 2019 [200]. The topic of breastfeeding problems was a very emotional issue for the mothers, they sought help from different sources (e.g., internet, books, health care professionals), applied different tools to help themselves (e.g., nipple shields, breast pumps, balms, malt beer) and experienced self-doubt, guilt, pressure, psychological stress, and feelings of failure. Partners mainly supported the women in their decisions and behavior and provided comfort, while the problems in some cases also caused emotional/physical distancing from the child and conflicts in social situations (e.g., jealousy when other mothers breastfed their babies) [200]. In addition, health care professionals who applied pressure or made inappropriate remarks were perceived as unhelpful and could exacerbate the situation [172]. Already after birth, some mothers felt irritated by different opinions regarding breastfeeding from health care professionals. Technical advice and emotional support from health care professionals, on the other hand, was perceived as very supportive [172].

Although the study had a small sample size, it also originated in Germany, the survey took place at a similar time as SuSe II, and the mothers surveyed were also motivated to breastfeed, the results of the study may also be applicable to a certain extent to SuSe II mothers with breastfeeding problems. The authors concluded that mothers with breastfeeding problems need to be treated in a sensitive way without exerting pressure [172]. In addition, contact with mothers with similar problems could help them overcome negative feelings and not give up their breastfeeding attempts too early [200].

Mothers can be surprised when their theoretical knowledge and the impression that breastfeeding is being something natural meet breastfeeding problems [172,201]. However, since breastfeeding problems do not seem to be the exception but rather the norm, as shown by SuSe and other studies [16,19,152,153,156], mothers wish to receive realistic information about breastfeeding and how to deal with difficulties at an early stage, as well as the education of family and society in this regard [202].

5.3.3.5 Maternal Education

Maternal education among SuSe II mothers as measured by the highest school-leaving qualification yielded significant results at four of the five time points (not at the time of discharge). Compared to mothers with a higher secondary education, mothers with a secondary education had lower odds of exclusively breastfeeding at four points in time (at the hospital (OR [95% CI]: 0.55 [0.38–0.78]); 2 weeks pp (OR [95% CI]: 0.63 [0.43–0.91]; 2 months pp (OR [95% CI]: 0.46 [0.31–0.66]); 4 months pp (OR [95% CI]): 0.62 [0.44-0.88]) and mothers with a basic education or another qualification at two points in time (2 weeks pp (OR [95% CI]): 0.42 [0.23–0.78]); 4 months pp (OR [95% CI]): 0.36 [0.18–0.75]) [97]. A low level of education was also negatively associated with breastfeeding in SuSe I [16].

In other studies besides SuSe, it was shown that maternal education is related to the initiation [95,184,203], exclusivity [204], and duration of breastfeeding [95,107,171,203,205,206]. Despite variability in categorization of education (number of comparison groups, school-only or job-related, depending on country and/or study design), mothers with lower education were less likely to achieve the recommendations compared to mothers with higher education [95,107,171,184,203,205,206]. Since education is associated with numerous factors (living conditions, behaviors, social participation opportunities) that are related to health [207], it could also have a multifactorial influence on the implementation of breastfeeding recommendations.

In both SuSe studies women with the highest school-leaving qualification were overrepresented [16,19,97]. This may indicate that the observed breastfeeding rates in the studies overestimated the actual breastfeeding rates in Germany at the time of the surveys. Nevertheless, between the two SuSe studies, there has also been an increase in women with the highest school-leaving qualification and a decrease in women with the lowest school-leaving qualification in the population in Germany [208], which might have had an overall favorable effect on breastfeeding rates over the years and might be reflected in the higher breastfeeding rates in SuSe II [96].

5.3.3.6 Cesarean Delivery

According to a literature review by Li et al. published in 2021, a planned Cesarean section is considered the most critical factor affecting breastfeeding [148]. Nearly half of the deliveries by Cesarean section in SuSe II were planned [19].

Although mothers in SuSe II were not asked about the reasons for having a planned Cesarean section, among maternal reasons cited in a qualitative study from Norway published by Eide et al. in 2019 were fear of birth (either due to previous traumatic birth experience in multiparous women or an alienation towards the idea of giving birth in first-time mothers) and the opinion of having a high risk for an emergency Cesarean section (e.g., due to hereditary factors, or previous birth outcomes) [209]. From the perspective of obstetricians, some maternal requests were not well-founded [209].

In a prospective cohort study from Alberta, Canada, the impact of a Caesarean section on breastfeeding initiation, duration and difficulties in the first 4 months pp among 3,021 women with singleton infants was analyzed [210]. Compared to women with emergency Cesarean sections and vaginal births, more mothers who delivered by planned Cesarean section had no intention to breastfeed (2.7%, 3.4%, and 7.4%, respectively) or did not initiate breastfeeding (2.5%, 1.8%, and 4.3%, respectively). In addition, when controlling for maternal characteristics these mothers were more likely to discontinue breastfeeding before 12 weeks pp compared to women who delivered vaginally (OR [95% CI]: 1.61 [1.14–2.26]). On the other hand, women who had delivered by emergency Cesarean section had a higher proportion of breastfeeding difficulties (41%) and sought more support during hospital stay (67%) and after discharge (58%), compared with the other two types of delivery (vaginal delivery: 29%, 40%, and 52%, respectively; planned Cesarean section: 33%, 49%, and 41%, respectively). However, in the adjusted analysis, no significant difference was found between women who delivered by emergency Cesarean section and women who delivered vaginally with respect to breastfeeding cessation (OR [95% CI]: 1.22 [0.91–1.62]) [210].

Semi-structured interviews with open-ended questions on breastfeeding intentions and early challenges with 115 women who had delivered by Cesarean section in England revealed that breastfeeding was complicated by limited mobility and post-operative maternal pain after a Cesarean section [211]. In addition, mothers expressed confusion about feeding cues and physiologic conditions of their infant, for some mothers formula feeding to calm their infant was a relief because it allowed them to gain more rest, and mothers who gave positive reasons for breastfeeding that related only to their infants were less likely to plan to breastfeed after discharge than mothers who gave motivations for breastfeeding that included benefits to themselves [211].

Because the above findings may also be reasons why the mode of delivery in SuSe II was associated with exclusive breastfeeding, it would likely be helpful to provide anticipatory guidance on breastfeeding to women planning a surgical delivery. Furthermore, mothers with an emergency Cesarean section could benefit from additional practical support [210]. The combination of parental education and targeted breastfeeding support was also cited as the only effective intervention for increasing breastfeeding initiation and continuation among mothers with a Cesarean section in the systematic review by Beake et al. [212].

5.4 Methodological Considerations

The study design of the SuSe studies offers advantages and disadvantages, which have been described in detail in the original publications and are briefly summarized below.

In both SuSe studies, but especially in SuSe II, the response rates of hospitals and mothers were rather low [96]. Maternal recruitment by hospital staff was uncompensated and might have been the decisive reason for hospital non-participation, in addition to increased time and budget constrains in hospitals in recent years [213]. For example, in the Austrian SUKIE study from 2019, a considerably higher percentage of hospitals participated compared to SuSe II (81% vs. 15.8%), but maternal recruitment in hospitals for the prospective survey was supported by trained, multilingual fieldworkers and, furthermore, there was no additional hospital survey [102], which significantly minimized the workload for hospitals.

The shortened hospital stay of mothers of 5 days in SuSe I and 3 days in SuSe II [96] may have resulted in the lower response rate of mothers in SuSe II. This may also have led to a higher percentage of mothers not being recruited in SuSe II due to a lack of opportunities to contact them prior to discharge. Whether the additional expense allowance of 30 euros for mothers in SuSe II had a positive effect on the response rate could not be assessed with the data available.

The decline in maternal response rates from SuSe I (1997–1998) with 52.1% to SuSe II (2017–2019) with 34.0% [96] is comparable to other national/regional studies in Germany [214–217] and seems to reflect the general decline in willingness to participate in health related surveys over the past decades [218,219]. For example, the response rate in the baseline survey of KiGGS reached 66.6% (2003–2006) and dropped thereafter to 38.8% in wave 1 (2009–2012) and 40.1% in wave 2 (2014–2017) [214–216]. The response rates in two regional studies from Ulm, Germany, also decreased from 67% (2000–2001) to 49% (2012–2013) [217].

Although the response rate of SuSe II is the lowest in comparison, it is at a similar level as the Norwegian Mother and Child Cohort Study (1999–2006) and the Swiss Infant Feeding Study (2014) with response rates of 43.5% and 40%, respectively [220,221].

Due to the overrepresentation of mothers with a high school-leaving qualification in both SuSe studies and the significantly more frequently represented certified hospitals in the hospital collective (25.7% vs. approx. 15.6% in 2017) [96,164], there is a risk of a selection bias towards an overestimation of breastfeeding friendliness and thus a lack of transferability of the results to whole Germany. Also, due to exclusion criteria such as the need for mothers to have sufficient knowledge of the German language in order to answer the questionnaires and the resulting underrepresentation of mothers of non-German origin, the results are not representative. However, in order to enable a comparison of the two SuSe studies in the context of breastfeeding monitoring, an adjustment was deliberately omitted.

The long-term participation rate of mothers of about 90% in both studies [96] indicates the general suitability of the survey and recall bias may have been minimized by the prospective assessment. In addition, the online assessment in SuSe II enabled mothers to answer questionnaires within about 15 min, bypassing the postal mail and eliminating the risk of interviewer bias that might have existed during the phone interviews in SuSe I. However, a weakness of the online survey is that no queries could be made in case of comprehension problems and due to the study design, it was not possible to verify the online information provided by the mothers and hospital staff.

Despite the stated weaknesses, the SuSe studies also have numerous strengths. A major strength is the simultaneous collection of nationwide hospital and maternal data using international definitions and recommendations [11,49,58]. This allows data comparison both within Germany at two time points and on an international level. This method of data collection also enabled the targeted linkage of hospital data on breastfeeding promotion and maternal data with prospective breastfeeding assessments in the critical neonatal period. For breastfeeding monitoring, which aims to use a variety of data collection methods to obtain a wide range of data on breastfeeding [91], the SuSe studies provide important insights beyond breastfeeding rates, such as starting points for breastfeeding promotion in hospitals or further support options for mothers [96,97].

5.5 Perspectives for Breastfeeding Promotion in Germany

The SuSe data and their discussion in an international context can be useful to show trends in the context of breastfeeding monitoring as part of the National Strategy for the Promotion of Breastfeeding in Germany. By repeating SuSe using the same study design and taking into account the limitations associated with it, it was possible to show that breastfeeding promotion efforts may have had an effect, as suggested by the generally better implementation of the 10 Steps in SuSe II hospitals compared to SuSe I hospitals and the higher breastfeeding rates in the maternal collective of SuSe II compared to the maternal collective of SuSe I [96].

With regard to breastfeeding promotion in hospitals in relation to the 10 Steps, the results indicate further need for improvement, such as regular staff training (Step 2) or early initiation of breastfeeding (Step 4) [96], but also the importance of implementing as many steps as possible for a good breastfeeding start [97]. Developments in the health care system in the last 20 years may also present particular challenges for future promotion of breastfeeding in hospitals [96]. In-hospital support should be tailored to the mother's individual (breastfeeding) situation (e.g., after a Caesarean section) and - taking into account the shortened pp hospital stay - to the existing follow-up care. The integration of the 10 Steps into national policies and standards and the provision of adequate resources for maternity hospitals by the healthcare system could support hospitals to implement the 10 Steps [58]. In addition, breastfeeding education and training using evidence-based guidelines for relevant occupational groups in contact with pregnant women and mothers, as envisaged in the National Breastfeeding Strategy [90], has the potential to make a positive contribution to breastfeeding promotion in hospitals.

Known maternal determinants related to breastfeeding success or failure, such as breastfeeding experiences [92,178,179], breastfeeding problems [95,152,156], or pacifier use [123,129–132], were confirmed in the SuSe II analysis [97] and indicate the need for a targeted approach to these factors, which could again include targeted education and training of relevant occupational groups with needs-based information and communication to families. Evidence-based information should present breastfeeding in a realistic manner, compatible with everyday life. Families should be supported from pregnancy through birth to the end of the breastfeeding period [90].

Taken together, Germany has the potential to further increase breastfeeding rates. For this purpose, the recommendations of the BBF project implemented in the National Breastfeeding Strategy could be used, which, in addition to surveys covering the social diversity of the population such as KiGGS or via the IQTIG, also envisage prospective studies at regular intervals of, e.g., 5 years within the framework of breastfeeding monitoring [90,93]. Although this would not allow any direct causal conclusions to be drawn about the effectiveness of the individual measures, important developments could be captured.

6. Conclusion

Compared to the first SuSe study 20 years earlier, SuSe II showed an improvement in breastfeeding promotion in maternity hospitals and in breastfeeding prevalence in the first year of life in Germany [96]. Improvements in breastfeeding practices have also been observed in most high-income countries over the years [100,101]. However, given the lower participation rates of hospitals and mothers in SuSe II compared to SuSe I, it is not possible to disentangle the potential roles of sample selection or breastfeeding promotion activities for the overall favorable development. To better reflect the diversity of hospitals and mothers for targeted breastfeeding promotion in the future, the comprehensive survey design of SuSe should be complemented by other approaches. In addition, providing more resources could allow researchers and hospitals to effectively recruit mothers for surveys, especially in the light of today's short stay on maternity wards.

The results of the SuSe II study further demonstrated that even in settings with relatively high breastfeeding rates and a high-quality mother-infant care system, it is essential to encourage hospitals to engage in breastfeeding support [96,97]. A high level of commitment of well-trained health care professionals needs to be complemented by tailored support of mothers in their social environments to empower them in the management of breastfeeding, as this combination is a critical component for sustained breastfeeding.

7. Summary / Zusammenfassung

7.1 Summary

Human breastmilk is the gold standard for infant feeding [2]. Breastfeeding offers multiple benefits to the breastfed infant, the lactating mother, and the society [3,4]. Therefore, professional societies in Europe recommend exclusive or full breastfeeding for at least 4 months after birth, followed by age-appropriate complementary feeding introduced no later than the beginning of the 7th month along with partial breastfeeding for as long as mother and infant desire [6,7]. However, many mothers do not achieve this recommendation, because various determinants hinder them to breastfeed successfully [8,9]. In order to improve breastfeeding practices numerous international initiatives have been launched [10–12,53]. In this context, breastfeeding monitoring is envisaged for the regular collection and evaluation of breastfeeding data, e.g., to enable targeted breastfeeding promotion at the national level [14,15]. In Germany, the two SuSe studies (SuSe I 1997–1998; SuSe II 2017–2019) provided data within the framework of breastfeeding monitoring [16–20].

In the present thesis, data from the two SuSe studies were compared and associations for breastfeeding success were examined. The analyses showed that both, maternal breastfeeding behavior and breastfeeding promotion in maternity hospitals were more in line with the recommendations in SuSe II than in SuSe I. Seven of the 10 Steps were implemented to a greater extent in SuSe II hospitals than in SuSe I hospitals and more mothers exclusively breastfed for 4 months (57% vs. 33%) and continued partial breastfeeding until 12 months pp (41% vs. 13%) [96]. In SuSe II, a high level of breastfeeding promotion in the hospital favored exclusive breastfeeding in the hospital setting, while maternal factors such as no early use of a pacifier and preexisting breastfeeding experience were stronger predictors of longer-term exclusive breastfeeding success [97].

Although these findings cannot be generalized to all mothers and maternity hospitals in Germany and do not allow causal conclusions to be drawn about the effectiveness of individual interventions, they nevertheless provide important insights for breastfeeding promotion in Germany and point to targeted promotion needs in order to further increase breastfeeding rates.

7.2 Zusammenfassung

Muttermilch ist der Goldstandard für die Säuglingsernährung [2]. Das Stillen bietet zahlreiche Vorteile für den gestillten Säugling, die stillende Mutter und die gesamte Bevölkerung [3,4]. Deshalb empfehlen verschiedene Fachgesellschaften in Europa das ausschließliche oder volle Stillen für mindestens 4 Monate nach der Geburt, gefolgt von altersgerechter Beikost eingeführt spätestens mit Beginn des 7. Monats und weiterem Teilstillen, solange Mutter und Kind dies wünschen [6,7]. Viele Mütter erreichen diese Empfehlung jedoch nicht, weil sie durch verschiedene Faktoren daran gehindert werden, erfolgreich zu stillen [8,9]. Um die Stillpraxis zu verbessern, wurden zahlreiche internationale Initiativen ins Leben gerufen [10–12,53]. In diesem Zusammenhang ist auch ein Stillmonitoring zur regelmäßigen Sammlung und Auswertung von aktuellen Daten zum Stillverhalten vorgesehen, um z.B. eine gezielte Stillförderung auf nationaler Ebene zu ermöglichen [14,15]. In Deutschland lieferten die beiden SuSe-Studien (SuSe I 1997–1998; SuSe II 2017–2019) Daten im Rahmen des Stillmonitorings [16–20].

In dieser Arbeit wurden Daten der beiden SuSe-Studien miteinander verglichen und Zusammenhänge mit dem Stillerfolg untersucht. Die Analysen zeigten, dass sowohl das Stillverhalten der Mütter als auch die Stillförderung in den Entbindungskliniken in SuSe II eher den Empfehlungen entsprach als in SuSe I. Sieben der 10 Schritte wurden in SuSe II häufiger umgesetzt als in SuSe I und mehr Mütter stillten 4 Monate lang ausschließlich (57% vs. 33%) und setzten das Teilstillen bis 12 Monate nach der Geburt fort (41% vs. 13%) [96]. In SuSe II begünstigte ein hohes Maß an Stillförderung in der Klinik das ausschließliche Stillen im Krankenhaus, während mütterliche Faktoren wie keine frühe Gabe eines Schnullers und bereits vorhandene Stillerfahrungen stärkere Prädiktoren für den längerfristigen ausschließlichen Stillerfolg waren [97].

Obwohl die Ergebnisse nicht auf alle Mütter und Entbindungskliniken in Deutschland übertragbar sind und keine kausalen Rückschlüsse auf die Wirksamkeit der einzelnen Maßnahmen zulassen, liefern sie dennoch wichtige Erkenntnisse für die Stillförderung in Deutschland und weisen auf gezielten Förderbedarf hin, um die Stillraten weiter zu erhöhen.

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List of Publications and Presentations

Articles in international and national journals (besides the included articles)

- Doru B, **Hockamp N**, Sievers E, Hülk P, Lücke T, Kersting M (**2023**) Adherence to recommendations for nutrient supplementation related to pregnancy in Germany. *Food Science & Nutrition*, 11(9):5236-5247 (Impact Factor: 3.9). DOI: https://doi.org/10.1002/fsn3.3482.
- **Hockamp N**, Sinningen K, Kersting M, Lücke T (**2023**) Ernährung im 1. Lebensjahr – aktuelle Themen und Fragen. *VFEDaktuell PLUS*, 195:20–25.
- Jansen K, Voss, S, **Hockamp N**, Hanusch B, Kersting M (2021) Kinderernährung – Aktuelles aus Forschung und Anwendung am Forschungsdepartment Kinderernährung. *VFEDaktuell PLUS*, 182:36–43.
- Kersting M, **Hockamp N**, Burak C, Lücke T (**2020**) Studie zur Erhebung von Daten zum Stillen und zur Säuglingsernährung in Deutschland – SuSe II. In: Deutsche Gesellschaft für Ernährung (Hrsg.): 14. DGE-Ernährungsbericht. Vorveröffentlichung Kapitel 3. Bonn, V1–V34.
- Kalhoff H, Jansen K, Drozdowska A, Hanusch B, **Hockamp N**, Voss S, Lücke T, Kersting M (**2020**) Ernährungsmedizin und Ernährungswissenschaft. Konzepte und Projekte aus dem Forschungsdepartment Kinderernährung der Universitätskinderklinik Bochum. *Pädiatrische Praxis*, 94/2.
- Klingelhöfer I, **Hockamp N**, Morlock GE (**2020**) Non-targeted detection and differentiation of agonists versus antagonists, directly in bioprofiles of everyday products. *Analytica Chimica Acta,* 1125:288–298 (Impact Factor: 6.2). DOI: https://doi.org/10.1016/j.aca.2020.05.057.

Articles <u>submitted</u> in international and national journals

- Kersting M, Sievers E, **Hockamp N**, Kalhoff H, Lücke T. Getting breastfeeding started under pandemic visiting restrictions: lessons learned in Germany Breastfeeding under pandemic restrictions. *International Breastfeeding Journal*.
- Thinnes M, **Hockamp N**, Sievers E, Lücke T, Kersting M. Assessment of breastfeeding promotion in maternity hospitals – results of a nationwide survey in Germany. *Child: Care, Health & Development*.
- Kersting M, Sievers E, **Hockamp N**, Hanusch B, Lücke T. Stillförderung in der klinischen Geburtshilfe während der COVID-19-Pandemie: Ergebnisse der SINA-Studie NRW. *Bundesgesundheitsblatt – Gesundheitsforschung – Gesundheitsschutz.*

Presentations

Oral Presentations [Invited Speaker]

- **Hockamp N**. Stillförderung in Zeiten von Corona. 2. Kinderernährungstag: Kinderernährung im Fokus II – Aktuelle Daten und Konsequenzen. Forschungsdepartment Kinderernährung, Universitätskinderklinik Bochum, **06.05.2023**, St. Josef-Hospital, Bochum**.**
- **Hockamp N**. Stillförderung in Zeiten von Corona rund um die klinische Geburtshilfe. Kongress für Kinder- und Jugendmedizin. Deutsche Gesellschaft für Kinder- und Jugendmedizin e. V., **07.-10.09.2022**, Congress Center Düsseldorf.
- **Hockamp N**. Stillen – was kann man aus SuSe II für die Stillförderung lernen? ERNÄHRUNG 2022 – Medizin fürs Leben. Deutsche Gesellschaft für Ernährungsmedizin e. V., **23.-25.06.2022**, Congress Centrum Bremen.
- **Hockamp N**. Stillen und Säuglingsernährung in Deutschland – Ergebnisse aus SuSe II. 28. VFED Online-Kongress. Verband für Ernährung und Diätetik e. V., **18.-20.09.2020.**

Poster Presentations

- **Hockamp N**, Sievers E, Hanusch B, Abram F, Voß S, Lücke T, Kersting M. Informationsverhalten von Müttern zum Stillen vor und während der Covid-19-Pandemie – Ergebnisse aus der SINA-Mütterstudie in NRW. 60. Wissenschaftlicher Kongress der Deutschen Gesellschaft für Ernährung e. V.: „Pflanzenbasierte Ernährung im Fokus – vielseitig und zukunftsfähig“, **15.-17.03.2023**, Bonn.
- **Hockamp N**, Hülk P, Lücke T, Kersting M. Update on breastfeeding promotion in maternity hospitals and breastfeeding rates in Germany – the SuSe studies. ISRHML 2021 LIVE ONLINE. The International Society for Research in Human Milk and Lactation, **16.-20.08.2021**.
- **Hockamp N**, Hülk P, Lücke T, Kersting M. Breastfeeding Promotion in German Maternity Hospitals and Consecutive Rates of Exclusive Breastfeeding During the First 4 Months of Life – The Prospective SuSe II Study. NUTRITION 2021 LIVE ONLINE. American Society for Nutrition, **7.-10.06.2021**.
- **Hockamp N**, Burmann A, Lücke T, Kersting M. Einnahme von Nahrungsergänzungsmitteln vor und während der Schwangerschaft – Ergebnisse der SuSe-II-Studie. 58. Wissenschaftlicher Kongress der Deutschen Gesellschaft für Ernährung e. V.: „Ernährung heute – individuelle Gesundheit und gesellschaftliche Verantwortung“, **17.-19.02.2021**, online.
- **Hockamp N**, Hülk P, Burmann A, Rudolf H, Lücke T, Kersting M. Stillförderung in deutschen Geburtskliniken und ausschließliches Stillen in den ersten 4 Monaten nach der Geburt - Ergebnisse der SuSe-II-Studie. 58. Wissenschaftlicher Kongress der Deutschen Gesellschaft für Ernährung e. V.: „Ernährung heute – individuelle Gesundheit und gesellschaftliche Verantwortung“, **17.-19.02.2021**, online.

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