Chapter

Cesarean Section and Breastfeeding Outcomes

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Abstract

The cesarean section rates in the developed countries are well above the 5% to 15% rate of all births as suggested by the World Health Organization (WHO) in 2009 and currently range widely between 25% and 50%. Moreover, the WHO guidance promotes early breastfeeding initiation during the first hour postpartum, exclusive breastfeeding up until the 6th month and maintaining breastfeeding at least up to the second year of the infant's life. In this review, we discuss the current evidence on whether a cesarean section interferes with the initiation and the long-term duration of breastfeeding practice among new mothers. The literature shows that a cesarean birth does have a detrimental effect on breastfeeding outcomes, however it is not per se a negative factor. It rather seems that infants who have feeding difficulties in the immediate postpartum period may experience long term problems. Therefore, interventions are discussed to promote breastfeeding after cesarean section for health professionals. Emphasis is given on promoting early skin-to-skin contact and on counseling new mothers about the advantages of breastfeeding as well as providing practical support and guidance throughout the early postpartum period.

Keywords: breastfeeding, cesarean section, cesarean birth, outcomes, interventions, neonate, mode of birth

1. Introduction

Even though there is no global consensus on the optimal rate of cesarean section (CS), nevertheless the World Health Organization (WHO) advocates that this should be approximately 15% of all live births [1]. Many developed countries over the past 30 years are well in excess of this rate, without there being any significant improvement in either maternal or neonatal outcomes [2]. A study conducted on a worldwide scale using country-level data has found that as CS rates exceed 10% and increase up to 30% there is no essential effect on reducing maternal and neonatal morbidity or mortality rates. Moreover, the initial inverse relationship observed between CS rates and morbidity or mortality appears to be explained by socioeconomic factors [3].

The latest epidemiological data from Western countries has placed Greece among those with the highest CS rates reaching 54% for the year 2018 [4]. This rising CS trend however is not uncommon and represents a universal finding over the past decades [5]. The CS rate for 2019 in Canada was 29.1% [6] and for 2018 in the United States of America was 31.9% [7], whereas in the United Kingdom was 26.1% (**Figure 1**). Since an increasing number of women delay their first pregnancy

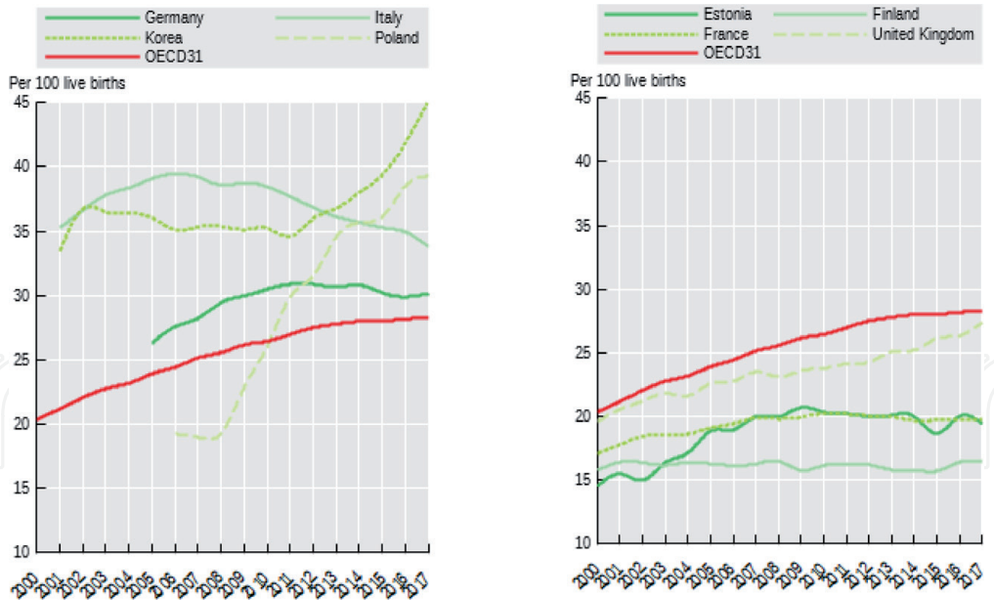

Figure 1.
Cesarean section trends in selected OECD countries for the time period between 2000 and 2017. (Source: OECD Health Statistics 2019. Access: https://DOI.org/10.1787/888934017937).

until after the third decade of their life and as the percentage of women with obesity is getting higher, this constitutes a high-risk environment for more CS births in the future [8]. At present, it is contemplated that one in three newborns are born with a CS worldwide.

2. Mode of birth and the neonate

2.1 Neonatal outcomes

Cesarean birth has been associated with a variety of adverse neonatal outcomes in the literature. Fetal and neonatal complications include the increased risk for neonatal intensive care unit admission, respiratory morbidity, and mother-infant separation with all its consequences [9]. While CS delivery has been regarded as a method to reduce the risk of neonatal asphyxia, Kupari et al. [10] in their review found that the rate of neonatal intensive care admissions is higher after a cesarean birth. A recent study at a university based-tertiary hospital in Jordan showed that 50.5% of all deliveries were by CS, and from those 72% were performed at term. However, 30% of the newborns with a cesarean birth were admitted to the neonatal intensive care unit (NICU). The rate of NICU admissions was 23% among the elective ceserean births when compared to 43% among the emergency ceserean births. It is noteworthy that among the term neonates who were admitted to the NICU almost two thirds were born by elective CS between 37 and $38^{6/7}$ weeks of gestation. Moreover, an estimated 18% of NICU admissions were complicated by sepsis and the mortality rate was 5% [11]. An earlier study also showed that an elective CS is associated with an almost two-fold increase in the rate of newborn transfers to the neonatal intensive care unit, and in the diagnosis of transient tachypnea of the newborn when compared with a planned vaginal birth [12].

Recent studies have highlighted the close interplay between host genetics, the prenatal environment and the route of birth on determining the newborn's microbiome at birth. There is emerging evidence that neonates born by CS have different hormonal, physical, bacterial, and medical exposures, and that these exposures can

subtly alter their physiology. The short-term risks of CS include the altered immune system development, the increased likelihood of allergy, atopy and asthma, and the reduced diversity of the intestinal microbiome. It is not clear in the literature how these alterations might affect the children's health later on in life as young adults, although there is accumulating evidence of long-term effects. In the literature it is quoted that we have just started to realize the importance of the developing neonatal microbiome for the future health outcomes of the individual [13].

Formation of the microbiome begins *in utero* and the resulting disturbances may lead to changes in the fetal epigenetic programming [14]. Factors related to the labor and birth environment have been shown to influence the initial colonization process of the newborn microbiome. Studies have shown that there are distinct differences in the microbiome profiles of newborns born vaginally when compared to those born by CS [15]. The microbiome signature of pregnancy is dynamic and it changes throughout gestation even though the factors that regulate such changes are not yet fully understood [16]. It is possible that gestational changes in the microbiome may occur as a natural mechanism to prepare for the initial transfer of microbes to the newborns [15].

There is evidence showing that children born by a CS versus those born vaginally are more likely to develop immune-related disorders such as asthma and allergies [17], inflammatory bowel disease [17], and obesity [18]. These findings have led some researchers to suggest that the association between chronic disease and route of birth may be caused by alterations in the microbiome seeding of the neonate following the cesarean birth [19]. The hypothesis is that the mode of delivery affects the epigenetic state of the stem cells of the newborn, thus impacting on their plasticity and responsiveness later on in life [14]. It is important to note that neonates born to a CS when compared to neonates born vaginally have a smaller degree of similarity to the intestinal microbiome of their mother, which includes skin and oral cavity microbes, and bacteria from the operating room [18]. Furthermore, it has been shown that children with a slight exposure to their mother's vaginal microbiome during labor, even if they were delivered by a CS, have a reduced risk of developing asthma than those born with an elective CS [17].

There is evidence that the previously described differences in the microbiome remain long term, and the adults who were born with a CS have fecal microbiota that are distinctly different from those of adults who were born vaginally [20].

2.2 Alterations to the neonatal microbiome

It has been shown that for neonates born with a CS, their microbiome consists of different maternal microbiota than in neonates born vaginally. Bacteria from the operating room [18] have also been found to be present, while the antibiotics that women receive intrapartum to reduce the risk of post-operative infection may also affect the newborn's microbiome [21]. The question that has been raised in the literature is how the neonate can counter these alterations in its microbiome. An intervention that has been proposed involves the medical, midwifery and nursing personnel adopting a mother-friendly, family-centered approach in the operating room during the cesarean birth [15]. Early skin-to-skin contact with the neonate, early initiation of breastfeeding and support in a maternal-focused environment with a concurrent reduction of the time-spams of separation between the mother and the newborn while the neonate is hosted in the nursery, may also result in minimal disturbances to the neonatal microbiome. Breastfeeding after a cesarean birth may potentially be the way to minimize the adverse effects of the mode of delivery on the neonate's microbiome by promoting optimal early newborn microbiota formation. This may occur despite the effect of the antibiotics given to the mother

during the CS, which have been found to lower the counts of *Bifidobacterium* species in breast milk that are known to prevent infection and to provide anticarcinogenic capacities to the newborn [22].

Epigenetic programming during the perinatal period may induce very important physiological changes to the neonate. Potential adverse events may lead to epigenetic changes with serious implications for health and disease. There are studies as discussed earlier that suggest that epigenetic alterations are linked to early life environmental stressors such as the mode of delivery. However, it seems that epigenetic modifications due to perinatal environmental exposures can be potentially reversible [14]. It seems that during the first 3 years of life starting from conception to the second birthday of the child, there is a high turnover of the different types of colonizing bacteria, after which the microbiome is more stable [23].

3. CS and breastfeeding

3.1 The benefits of breastfeeding to the neonate and the mother

Among the postnatal factors that may contribute to lifelong health and disease through epigenetic mechanisms, infant feeding seems to play a key role (**Table 1**) [23]. Maternal breast milk is universally considered to be the normative standard for infant feeding, as it confers unique nutritional and non-nutritional benefits that could in some extent be explained through epigenetics [24]. WHO promotes early breastfeeding initiation during the first hour postpartum, exclusive breastfeeding up until the 6th month and maintaining breastfeeding up to the second year of the infant's life or more in order to optimize its growth, development and good health [25]. The special content of breast milk with long chain poly-unsaturated fatty acids [26], oligosaccharides [27], lactoferrin [28] and other important nutrients makes it the ideal nutrition for newborns and infants.

A meta-analysis on the short-term effects of breastfeeding has indicated that breastfeeding reduces the severity of diarrhea and the risk of hospitalization and mortality due to respiratory infections by 72% and 77%, respectively [29]. With regards to the long-term effects of breastfeeding, another meta-analysis was performed by the World Health Organization in 2007 and was updated in 2013. The most recent meta-analysis suggests that a causal association exists between

Nutrition			
Maternal nutrition	**Neonatal & infant nutrition**	**Microbiome**	**Epigenome**
Over-/ under-nutrition	Breast milk	Maternal microbiota	Human genome
Vitamin D status	Formula milk	Mode of delivery	Environmental factors
Dietary methyl donors	Prebiotics/probiotics	Maternal & infant diet	
LCPUFA* intakes		Antenatal & post-natal antibiotic exposure	
Food pollutants		Urban/rural environment	

Data from Ref. [23].
**Long chain polyunsaturated fatty acids.*

Table 1.
Significant factors affecting the long term health outcomes over the first 1,000 days of life.

breastfeeding and the increased performance in intelligence (IQ) tests during childhood and adolescence, and has been estimated to lead to an average increase of 3.5 points of IQ score. Though the maternal intelligence scoring (IQ) was acknowledged as an important confounder, nevertheless it accounted for a small part of this association. The practical implications of this finding of the small increase of performance in intelligence tests are not yet clear [30].

The meta-analysis of 2013 also found a small reduction of about 10% in the prevalence of overweight or obese children exposed to longer durations of breastfeeding. However, there were confounding factors related to this finding since in the majority of study settings the duration of breastfeeding was higher in families with a higher educational and economic status. Breastfeeding was also found to have a protective effect against type-2 diabetes particularly among adolescents. Furthermore, a small protective effect of breastfeeding against systolic blood pressure was found, however as the authors state, residual confounding cannot be ruled out [30]. Finally, the American Association of Pediatrics [31] states that breastfeeding plays a protective role against the sudden infants death syndrome.

Breastfeeding confers numerous short-term and long-term benefits to the mother [25]. Women who do not breastfeed are in a greater risk of developing breast cancer and ovarian cancer [32, 33]. The protective role of breastfeeding is even greater among mothers with the BRCA1 mutation, and it has been estimated that those who breastfeed for at least one year have a 37% lower risk of breast cancer [34]. There is growing evidence indicating that breastfeeding seems to have a protective role against obesity later on in the mother's life [35]. Breastfeeding also confers a lower risk of developing diabetes mellitus [36] and hyperlipidemia [37]. Studies have shown that even a single month of breastfeeding significantly reduces the risk of developing diabetes in later life [38]. Finally, it seems that breastfeeding and especially long term with a duration of more than 7 months, reduces the maternal risk of hypertension and cardiovascular disease [39, 40].

3.2 Cesarean birth and the initiation of breastfeeding

Though the importance of breastfeeding is well established in the literature, the way by which the mode of delivery interferes with breastfeeding is still obscure. A systematic review and meta-analysis has shown that newborns born with a CS are almost half as likely to initiate breastfeeding before hospital discharge when compared to newborns born vaginally [41]. There is an abundance of literature reports since the late 1990's showing that women who deliver by CS are less likely to breastfeed and most probably will delay breastfeeding initiation. A recent study in Canada found that women planning to have a cesarean birth had no intention to breastfeed or did not initiate breastfeeding (7.4% and 4.3%, respectively) when compared to women with vaginal births (3.4% and 1.8%, respectively) [42]. This finding is further supported in the literature by a study from Ohio in the United States of America indicating that women who underwent a scheduled repeat cesarean delivery were less likely to initiate breastfeeding than those having a successful vaginal birth after a previous CS and those who ultimately delivered by cesarean birth after an unsuccessful trial of labor [43]. It seems that maternal choice for the mode of delivery may also influence her decision to breastfeed. This is a key element that needs to be thoroughly addressed by health care professionals, since to date the motivation of mothers to breastfeed is the most important determining factor for the success of breastfeeding. Another recent study in China calculated that the unadjusted odds ratio [OR] for lower breastfeeding rates associated with CS was 2.11 [95%CI: 1.58–2.81] and 1.36 [95%CI: 1.01–1.83] at the 5th day and 6th month post delivery. After adjusting for early breastfeeding behaviors, it is interesting that

the negative effect of CS on long term breastfeeding was attenuated and was no longer significant. In fact, the authors of this study noted that although cesarean birth had a detrimental effect on early breastfeeding behaviors and long-term breastfeeding outcomes, it is not *per se* a negative factor. It rather seems that infants who have feeding difficulties in the immediate postpartum period may experience long-term feeding problems [44].

The main question therefore is whether being born with a CS increases the difficulties in breastfeeding. There is evidence that a CS can act as an independent risk factor for reduced breastfeeding rates due to the difficulties of early lactation for the mother and baby. In a recent study, women having a CS experienced more difficulties with breastfeeding, while those having an emergency CS were more likely to have an unsuccessful first breastfeeding attempt and were unable to breastfeed their baby within the first 24 h and upon leaving the hospital, than those having a vaginal birth [42]. These difficulties might originate from maternal reasons such as the adverse effect of the administered anesthesia drugs [45], postpartum maternal fatigue after a long eventful labor, or due to postpartum wound pain after the surgery [46]. Mothers after cesarean birth report greater pain scores when compared to those women having a vaginal birth, and more problems with latching on and positioning of the baby during breastfeeding [47]. Mothers after a cesarean birth need to deal with some practical difficulties, such as having to try to breastfeed with a drip in their arm, or not being able to move around easily and pick up their babies as easily as mothers after a vaginal birth. These minor issues can enhance maternal fatigue and postpartum depressive feelings following the birth [46].

Moreover, there has been fair discussion in the literature about the hormonal impact of cesarean birth on lactogenesis. Lactogenesis is the process of developing the ability to secrete milk and involves the maturation of alveolar cells. Stage I lactogenesis takes place during the second half of pregnancy whereas stage II lactogenesis starts with copious milk production after delivery. As the placenta detaches after the delivery of the neonate, there is a rapid drop in progesterone which enables the other hormones that are present in high levels such as prolactin, cortisol and insulin, to stimulate breast milk production. It has been noted that in primiparous women, stage II is slightly delayed and early milk volume is lower. A lower milk volume was also observed in women who had cesarean births compared with those who delivered vaginally [48]. It is postulated that the hormonal pathway that stimulates lactogenesis is disrupted by a CS delivery, either because of maternal stress or decreased oxytocin secretion, and can hinder the milk production [49]. This means that mothers following a cesarean birth may encounter more practical difficulties while trying to breastfeed than mothers after a vaginal birth [50].

Another issue is the breastfeeding difficulties of the new-born after the CS delivery. It has been noted that neonates after a cesarean birth are more likely to display poorly coordinated tongue movements and to perform unsatisfactory infant sucking activity [51] due to drug exposure or to a long tiring labour. Neonates born by CS are more likely to have mucus secretions, which can affect how interested they are in feeding [52]. Intravenous fluids administered during labour can cause mothers' breasts to become swollen, making it harder for the newborn to latch on properly [53].

Another important inhibiting factor to breastfeeding after a CS is the psychological factor, namely the loss of confidence. Mothers and especially those after an emergency CS might be less likely to believe in their ability to nurture and feed their baby as they experience increased feelings of failure. In addition, their family members are usually more likely to suggest offering formula milk to the newborns so they could rest after the surgery [52]. This suggestion may sometimes also originate from the health care personnel along with the advice to keep the newborn at the

nursery for long periods of time or overnight in order for the mother to sleep. Long separation periods between the mother and newborn make lactation establishment more difficult. It is a vicious circle where mothers do not trust their body to produce enough milk, those around them make them feel that they are not capable of feeding their offspring and that leads mothers quitting breastfeeding before practically ever starting it [54].

One of the major factors that has been acknowledged for its contribution to breastfeeding success is the early onset of lactation. Unfortunately, it has been proven that cesarean birth neonates have a delay in their onset of lactation as in many cases mother to baby contact inside the operating theatre is delayed, and when offered it is usually shorter in duration than recommended or even absent [55, 56]. Skin-to-skin contact begins ideally at birth and should last continuously until the end of the first breastfeeding [57]. This practice involves placing the dried, naked newborn in a prone position on the mother's bare chest, and sometimes can be covered with a warm blanket. Women and newborns that practice skin-to-skin contact immediately after birth have been proven to show increased rates of breastfeeding at hospital discharge and up to six months postpartum [57].

3.3 Skin-to-skin contact after a cesarean birth

As mentioned above, early skin-to-skin contact is a key element for the success of breastfeeding as it leads to early initiation of breastfeeding and to the maternal hormonal response, that is the secretion of oxytocin and endorphins which are important to establish lactation [57]. Skin-to-skin contact provides however far more benefits for the mother and baby. This intimate contact evokes neurobehaviors that ensure the fulfillment of basic biological needs and affects the future programming of the infant's physiology and behavior [57]. It is beneficial for the newborns by improving their cardio-respiratory stability [57], their thermo- and glucose regulation [57, 58], and it also reduces the stress of birth while facilitating a smooth transition to extrauterine life [59]. Moreover, since newborns born by CS do not acquire maternal vaginal microbes, skin-to-skin contact immediately after birth permits the microbial colonization of the newborn with maternal skin microbiota [60]. Mothers after a cesarean birth also benefit by appropriate skin-to-skin contact with their newborns, since due to the boost in oxytocin secretion it has been found that the risk of postpartum hemorrhage is ameliorated [61]. In addition, it reduces maternal stress, anxiety, and pain during and after the CS delivery [57]. Long term, it seems that skin-to-skin contact has significant positive effects on reducing the maternal depressive symptoms and the physiological stress she experiences during the postnatal period [62].

Although the WHO guidelines [25] state that keeping the mother and baby together for at least the first hour after birth leads to an improved initiation and duration of breastfeeding, however it is not always as easy to apply for women having a CS and especially an emergency CS [63]. Nevertheless, skin-to-skin contact is recommended by the relevant health authorities such as the National Institute for Health and Care Excellence (NICE) [50] and the Pan American Health Organization [64]. It has been reported that early initiation and a long duration of skin-to-skin contact when compared to a short time duration, has a dose–response effect on breastfeeding [65]. A recent study has shown that for infants after vaginal delivery, the average time from birth to first breastfeeding was 40.91 minutes, while for CS newborns the average time was 74.54 minutes. The duration of the first breastfeeding was maintained for 18.33 minutes for babies after a vaginal delivery, and only 14.98 minutes for those after cesarean birth ($p = 0.00$). Newborns after a vaginal delivery maintained a longer sucking duration for the first ($p = 0.000$) and

second (p = 0.008) day postpartum. Correspondingly, cesarean birth newborns were more frequently (p = 0.000) supplied with formula, and they consumed more volumes (p = 0.000) of formula within the first 72 hours after birth [44]. In another quasi-experimental feasibility study in the United States of America, it was shown that women who practiced immediate skin-to-skin contact with their newborns during their CS surgery (within one minute after birth) were more satisfied with the experience and had lower levels of salivary cortisol across time (p = 0.015 and p = 0.003 respectively) than those who practiced early skin-to-skin contact (within the first hour after birth) [66]. It has been reported in the literature that in those cases where the mother is not capable of performing skin-to-skin contact during the surgery then the father can hold the baby [66, 67]. Although this can be a reliable alternative, a recent study found a statistically significant association between skin-to-skin contact with the mother and the exclusive breastfeeding rates upon discharge, which was maintained at three- and six-months postpartum, when compared to the groups that had paternal skin-to-skin contact or no skin-to-skin contact at all [67].

3.4 Cesarean birth and the duration of breastfeeding

As already mentioned, there is scientific evidence showing that a CS can lead to the early discontinuation of breastfeeding [68]. On the other hand, there are earlier studies showing that cesarean birth does not affect the duration of breastfeeding if women initiate breastfeeding from the time point of birth and maintain it for at least four weeks postpartum [69]. In a recent prospective cohort study of 3,021 women in Canada, it was shown that the mode of birth is a significant independent predictor for breastfeeding cessation at or prior to 12 weeks postpartum (p = 0.014). In the adjusted multivariable logistic regression model, women who had a planned CS were more likely to have early cessation of breastfeeding [≤12 weeks] [OR = 1.61; 95%CI: 1.14-2.26; p = 0.006] when compared to those who

Independent variable	Unadjusted OR (95% CI)	Adjusted OR [95% CI]
Mode of birth[d]		--[b]
Emergency cesarean	1.35 (1.03-1.76)[b]	1.22 (0.91-1.62)[a]
Planned cesarean	1.33 (0.97-1.82)[a]	1.61 (1.14-2.26)[b]
Low income	1.61 (1.25-2.06)[c]	1.58 (1.19-2.09)[b]
Lower education	2.14 (1.61-2.85)[c]	1.82 (1.31-2.53)[c]
No previous birth	1.38 (1.13-1.68)[b]	1.42 (1.13-1.77)[b]
Preterm birth	1.66 (1.18-2.33)[b]	1.54 (1.06-2.23)[b]
Maternal physical health	0.96 (0.95-0.98)[c]	0.96 (0.94-0.98)[c]
Maternal mental health	0.99 (0.98-1.00)[b]	0.99 (0.97-0.99)[b]
Caucasian	1.49 (1.14-1.95)[b]	1.67 (1.25-2.22)[c]
≥ 1 breastfeeding difficulty	2.09 (1.67-2.61)[c]	1.82 (1.43-2.31)[c]

Reproduced from Hobbs et al. [42].
[a]≥0.05.
[b]<0.05.
[c]<0.001.
[d]Reference group set as vaginal delivery.

Table 2.
Unadjusted and adjusted logistic regression model of mode of delivery on the duration of breastfeeding up to 12-weeks postpartum.

delivered vaginally. There was no significant difference in breastfeeding cessation between women who had an emergency CS and women who delivered vaginally in the adjusted analysis [42] (**Table 2**).

Another study found that cesarean births were associated with lower rates of exclusive breastfeeding at 6 months, with no difference found between planned versus emergency CS [70].

There is a large systematic review and meta-analysis on breastfeeding outcomes after cesarean birth that included data of 53 studies from 33 different countries. Prior and colleagues (2012) identified lower rates of any breastfeeding and exclusive breastfeeding at 6 months among women who had a cesarean birth (planned or unplanned) when compared with a vaginal birth (normal or instrumental). However, based on a subgroup analysis they found that although cesarean birth was associated with lower rates of initiation, those mothers who did initiate successfully were as likely to exclusively breastfeed at 6 months with those who had a vaginal birth. This important finding suggests that early interventions could be very effective following a cesarean birth in terms of establishing lactation and continuation of breastfeeding for a long period of time [41].

4. Effective interventions to promote early breastfeeding initiation following a cesarean birth

4.1 Prenatal preparation

Decisions about infant feeding are determined by a range of complex factors including the woman's socio-demographic background, age, ethnicity, and peer support network [71]. To date, the most important factor for the success of breastfeeding is the mother's motivation. As it has been commented earlier, mothers planning to have a cesarean birth report lower level of willingness to breastfeed their offspring [42, 43]. It has been reported in the literature that all health professionals need to look closely into this fact and identify the reasons that drive women to this decision. Antenatal programs addressing the importance of breastfeeding both for mothers and babies, with emphasis to the key effects on CS newborns' health need to be implemented. There is a false impression that women after a CS are not able to breastfeed adequately their offspring and this involves the women themselves, their families and exists even among health professionals. As mentioned above, women after a CS may face more difficulties than women following a vaginal birth but with adequate help and consultation from health professionals and their family, they are able to provide the best nourishment to their newborns. The women themselves express lack of knowledge and skills about breastfeeding after the CS birth [54]. During the antenatal courses, midwives have the opportunity and ability to provide this knowledge in a secure relaxed environment and demonstrate coping strategies that women can easily rehearse and learn prior to their birth. This way their confidence will increase, and they will feel more confident and ready to breastfeed their newborns after their CS.

4.2 The importance of adequate bonding time

We know from the neuroendocrine mechanisms involved in the initiation and maintenance of lactogenesis that the mother-to-newborn contact is the most effective and powerful stimulus to milk production. Health professionals need to ensure undisturbed immediate or early skin-to-skin contact for mothers and their newborns after a cesarean birth. Skin-to-skin contact is a practice that requires

minimal organizational effort or costs for the hospitals that offer it [67]. Numerous studies show that skin-to-skin contact is an easy to apply, low-cost and safe intervention that can have important health benefits both for the mother and newborn, as described in the previous sections. There are studies that prove the feasibility of applying this method to women undergoing an uncomplicated CS, and even on an emergent basis, while skin-to-skin contact can safely begin during surgery and continue uninterrupted for an extended time duration [66]. As an alternative, when the mother is not capable or willing to provide skin-to-skin contact, then the partner can assist and hold the newborn [67]. Furthermore, the health professionals need to ensure that the mother and newborn will have undisturbed time to bond by minimizing the separation time spams. This can be achieved with performing the clinical examination while the newborn is on the mother's arms, delaying the first newborn bath for after the first 24 hours, and by delaying the transfer of the mother while she is breastfeeding [50]. Rooming-in should be offered to all mothers as well as reassurance that the health professionals will be present to provide their assistance if needed, as the Family-Centered Care and the Baby-Friendly Hospital Initiative (BFHI) recommends [72]. Mothers following a cesarean birth will require more help handling their newborn, so the hospital policies should allow for a family member to be present or additional helping staff to be allocated. On the other hand, undisturbed bonding time with the newborn means that there should be a minimum number of visitors and in specified time frames during the hospital stay. Moreover, while breastfeeding there should be an indication on the door to keep people away from entering so as to preserve privacy and comfort.

4.3 Dealing with practical difficulties after a cesarean birth

In a recent qualitative study exploring the breastfeeding behavior of mothers following a cesarean birth, some of the main reported challenges for breastfeeding after a CS included the physical discomfort and the lack of knowledge and coping skills in managing their depressive mood after a CS [54]. It is important to realize that health professionals need to provide extra care and consultation to women after a CS. Women that feel greater levels of pain and discomfort are usually more easily to quit breastfeeding, as they feel that they are not able to do it properly. Health professionals need to provide encouragement, emotional support and empowerment to these women to adopt their nourishing role. They also need to provide adequate analgesia for mothers so as not to feel sore while breastfeeding [50]. It needs to be explicit that there are numerous analgesic and antibiotic drugs that are compatible with breastfeeding and women and their families need to be aware of that. At this point, it is important to comment that mothers who require anesthesia or sedation sometimes may receive inconsistent information from health care professionals regarding the passage of drugs into their breast milk. This can potentially lead to the interruption of feeding, discarding of their breast milk or early cessation of breastfeeding. A recent consensus document launched by the Association of Anesthetists and endorsed by the Royal College of Midwives and the Royal College of Obstetricians and Gynecologists clearly states that '*breastfeeding is acceptable to continue after anesthesia and should be supported as soon as the woman is alert and able to breastfeed, and that breast milk should not be discarded*' [73].

Health professionals need to provide consultation and guidance on a more practical level such as advising on different breastfeeding positions that women may find useful and comfortable after the surgery [50]. Midwives need to assist newborns to latch on effectively, especially if they are drowsy from medication or if the mothers' breasts are engorged after having intravenous fluids. They also need to ensure that the newborn is feeding frequently. In case the newborn cannot

breastfeed directly, they should assist the mother to express her milk and provide it to her newborn, so that the milk supply will be maintained and promoted.

Another very important element for health professionals is to provide the accurate birth weight to CS newborns. Researchers propose that using newborns' weight at 24 hours rather than the immediate weight after birth, could be a more accurate reference for weight loss and in turn could support breastfeeding by reducing supplementation rates in the absence of a clinical need. We know that fluids administered intravenously during labor due to the transplacental passage could lead to the newborn's weight inflation immediately after a cesarean birth [74]. In a recent study, it was noted that when the 24-hour weight was used as a reference among healthy full-term newborns delivered by CS, the overall supplementation rate decreased from 43.6% pre-intervention to 27.4% post-intervention, and in first-time mothers from 51.9% to 31.0% [75]. Thus, health professionals need to take under consideration these findings and not easily attribute any newborn's loss of weight to the lack of adequate milk supply which in turn can easily enhance maternal stress and lead to formula supplementation and no or less breastfeeding.

Women following a cesarean birth tend to face more practical difficulties with breastfeeding than women following a vaginal birth. Therefore, midwives and health professionals will need to offer ongoing support providing necessary advice and consultation on practical issues such as breastfeeding positions. Some comfortable breastfeeding positions for mothers after a cesarean birth include the following:

a. Lying down on the side position: This position keeps pressure away from the CS scar and is quite restful for the mother and baby, and the hand with the cannula does not pose any extra difficulties. However, the mother might need some extra help to roll over and breastfeed from the other side.

b. Lying back breastfeeding position: The mother is not sitting upright as she is laying backwards, and her body is supporting the baby's weight. The baby can be put diagonally so it does not apply pressure on the wound.

c. Rugby ball or under the arm position: The mother uses pillows to support her back and her baby under her arm. This position also keeps the baby away from the wound.

There are many different breastfeeding positions that a mother after a cesarean birth can try while breastfeeding. The most important element is to find a comfortable position for her that she can maintain for as long as her baby wants to feed. She also needs to feel free to ask for assistance from the health personnel while in hospital and from her family members while at home. It has been mentioned in the literature that women following a cesarean birth were not feeling comfortable asking for help from the health professionals as they considered it being a sign of failure, so they tried to endure as long as they could. This eventually led to exhaustion, frustration and the decision to quit breastfeeding quite early [54].

4.4 The significance of peer support and the partner's role

There is a growing trend on the use of social media and mothers' support groups among new mothers to find support and guidance while breastfeeding. The WHO has recently commented in a positive manner on their effectiveness to encourage women while breastfeeding. A recent Cochrane database systematic review on interventions for promoting the initiation of breastfeeding included 107,362 women from seven countries and found low-quality evidence that healthcare

professional-led breastfeeding education and non-healthcare professional-led counseling and peer support interventions can result in some improvements in the number of women beginning to breastfeed [76]. Another systematic review that tried to identify effective interventions for women having a cesarean birth to increase uptake and duration of breastfeeding, identified a limited number of effective interventions such as immediate or early skin-to-skin contact, parent education, the provision of side-bed bassinets when rooming-in, and the use of breast pumps. However, there was one study that tested a bundle intervention consisting of parent education and targeted breastfeeding support and found an increased initiation and continuation of breastfeeding [77]. Both of the above mentioned systematic reviews conclude that more research is needed to explore the effectiveness of several interventions that are initiated prior to conception or during pregnancy and postpartum.

The role of the father or partner during breastfeeding has also been supported in the literature. A quasi-experimental study in China has shown that families where fathers in the antenatal period were specifically informed about ways to support their wives with breastfeeding, maintained exclusive breastfeeding at four and six months postpartum in a larger proportion than families who received standard antenatal care [78]. A recent systematic review highlighted the value of including fathers or partners in interventions to support breastfeeding. The review showed that the inclusion of fathers or partners in breastfeeding interventions improves breastfeeding initiation, duration, and exclusivity rates. Interventions that include face-to-face information delivery, that are designed in a culturally appropriate manner, and provide information on how partners can support breastfeeding are more likely to have a beneficial effect [79]. In a recent qualitative study from Canada, it was shown that fathers themselves perceived their role as much more complex than the limited role of a breastfeeding facilitator that is usually attributed to them. They see themselves as stakeholders in decision-making on how their child is to be fed and they react to the imbalance created by breastfeeding. They want to be considered as partners during the decision-making and they acknowledge the importance of providing emotional and practical support to their breastfeeding spouses. The researchers of this study comment that health professionals need to include fathers in the parental preparation programs and should find ways to support them effectively in managing their various roles [80].

5. Conclusion

Cesarean births represent almost one third of all births globally. There is evidence showing that this medical intervention has an impact on women's infant feeding decision and leads to important breastfeeding difficulties that involve mainly the initiation and duration of breastfeeding. The WHO promotes breastfeeding as the ideal nutrition for all newborns and infants up to the sixth month of their life, and at least up to the second year supplemented with solid foods. Health professionals can play an important role on promoting women's breastfeeding behaviors after a cesarean section. Through high quality antenatal education programs they can assist women to change their attitudes and beliefs concerning the feasibility of breastfeeding after a CS and help them become more confident and committed. The preparation for breastfeeding after a CS should ideally start in the antenatal period. Health professionals can also implement immediate and uninterrupted skin-to-skin contact and minimize separation as the standard of care during and after an uncomplicated cesarean birth. They can also provide advice and important guidance and practical support after the birth to mothers and their family members to create a strong support network. The network of family members alongside

allocated health professionals can effectively assist during the lactation process in order to ensure that both the mother and infant receive the benefits of long-term breastfeeding.

Conflict of interest

The authors declare no conflict of interest.

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