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Feeding of the healthy neonate

(Revisions of the 2011 SSP Guidelines "Nutrition of the Newborn in the first days of life")

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Summary

Feeding is one of the major adaptive processes to extra-uterine life. Breastfeeding is the optimal way to feed neonates, as it is not only adapted to their gut, growth and development, but it also provides short and long-term benefits for infants, mothers and society. Absolute contraindications to breastfeeding are rare. While breastfeeding is most often possible under appropriate conditions and support, perinatal health care professionals play a critical role both to enhance its initiation and continuation and to prevent potentially detrimental interferences. Early and prolonged skin-to-skin contact, rooming-in, feeding on demand, adequate positioning and partner involvement are examples of proven supportive measures on maternity wards. Reinforced support is required in the presence of risk factors or signs of suboptimal breastfeeding. Supplements to human milk are rarely necessary for healthy, eutrophic, term neonates and indications should be carefully assessed and limited to situations when other supportive measures fail. Neonatal weight loss in the first days of life needs to be interpreted with caution. When breastfeeding is impossible, undesired, or insufficient, infant formula are appropriate alternatives. Mother's antenatally expressed colostrum or human donor milk can be considered as transient supplements depending on situations and their availabilities. Vitamin K and D complements are recommended to cover the infant's needs. Maternal nutritional status and diet deserve also consideration.

Introduction

Ten years after the last revision of the Swiss Society of Pediatrics (SSP/SGP) guidelines for feeding healthy neonates, the current version was revised by an interdisciplinary experts' group and endorsed by the Swiss Society of Neonatology (SSN), the Swiss Federation of Midwives, Swiss Gynaecology (SGGG) and the Swiss Breastfeeding Promotion. It aims to provide an updated, and, as far as possible, evidence-based guidance for paediatricians, neonatologists and other perinatal health care professionals. These guidelines particularly emphasize breastfeeding (BF) issues. They do not cover the management of at risk neonates such as preterm and sick term neonates, neonates at increased risk for hypoglycaemia, nor infant nutrition after the neonatal period, that are presented elsewhere.[1,2] Guidance dedicated to parents and the wider public is available elsewhere.[3–5] The following guidelines are organised into three main neonatal nutritional issues:
I. Breastfeeding, II. Breastfeeding supplementation and substitutes, III. Nutritional complements.

What is new compared to the previous guidelines?

- Additional information on BF such as benefits, barriers and support.
- Maternal HIV is no longer an absolute contraindication for BF in Switzerland.
- Maternal COVID-19 / SARS-CoV-2 infection is compatible with BF under adapted hygiene precautions.
- Assessment of BF success or supplementation based on integrative criteria rather than neonatal weight loss alone.
- Depending on their availability, mother's antenatally expressed colostrum or human donor milk from milk banks can be considered as alternatives for early supplementation.
- Updates on formula use and practical information for preparations.
- Nutritional complements: not only for neonates, but also for BF mothers with particular health conditions and/or diet.
- Harmonization with other recent national and/or international guidelines.

Definitions

Table 1. Definitions and abbreviations

Breastfeeding (BF)	Feeding a child with breastmilk, regardless of how it is received (at the breast or expressed)[6]
Exclusive BF	The infant does not receive any other liquid or solid food, except oral rehydration solutions or vitamins, minerals, drugs.
Mixed/partial BF	The infant receives other liquid or solid food as supplements.
Human milk (HM)	Milk secreted by the human mammary gland containing both nutrients and multiple bioactive components. Its composition is adaptive and dynamic. It can be differentiated into mother's own milk (MOM) and human donor milk (HDM).[7]
Colostrum	First HM secreted, often yellow coloured, particularly rich in proteins, antibodies, and white blood cells (± 1st week)
Transitional milk	Colostrum evolves to transitional milk corresponding to the period of lactation rise (± 2nd week)
Mature milk	After transitional stage, HM stabilizes and is considered as mature (>2nd week)
Infant formula	Industrial food preparation suitable for feeding infants as complete or partial substitute for HM
Complement	Drops / syrups of micronutrients complements such as vitamins or minerals[8]
Supplement	Additional fluids (e.g. formula, water) other than HM[8]
Healthy term neonates	Term neonate (37-42 weeks of gestation), with birthweight between 2500 and 4500 g (or 3rd and 97th percentiles for gestational age), without any disease nor increased risk for hypoglycaemia (such as maternal diabetes or hypothermia <36.5°C).[1]

I. Breastfeeding

I.1 Advantages of breastfeeding

BF provides major benefits for the short and long-term health of mother and child with a positive economic impact for families and society. These benefits may vary depending on the duration and exclusivity of BF.[9–13]

- **Main benefits for child health:**
  - *Short-term*: Lower incidence of sudden infant death syndrome and infections (gastroenteritis, otitis, bronchitis, bronchiolitis, among others). BF also helps in reducing pain in neonates undergoing painful procedures.[14]
  - *Long-term*: Contribution to the reduction of non-communicable diseases risk (obesity, diabetes, metabolic syndrome). Controversial evidence on allergic prevention (particularly in familial atopy).[15] Possible risk reduction of certain immunologically mediated diseases (e.g. inflammatory bowel disease, celiac disease) and leukemia. It also seems to support neurodevelopment.
- **Main benefits for maternal health:**
  - *Short-term*: Decreased postpartum bleeding and menstrual blood loss, increased birth spacing, and possibly a faster return to pre-gestational weight.
  - *Long-term*: Reduced risk of type 2 diabetes, cardiovascular diseases, gynaecological cancers (breast, ovary, endometrium), and osteoporosis.
- **Other benefits:**
  - *Bonding*: Possible protective effect against post-partum depression.
  - *Economical:* Cheaper than infant formula; fewer medical consultations and infant hospitalizations, and less parental absenteeism from work.[16,17]
  - *Environmental*: Minimal or no waste, fewer resources compared to formula.[18]

I.2 International and Swiss recommendations for breastfeeding

WHO and Unicef recommend to initiate BF within the first hour of life, and to breastfeed exclusively for 6

months, and then alongside the introduction of complementary foods up to 2 years of age or beyond.[19] In line with the European guidelines[10] and those of other high-income countries, the SSP/SGP recommendations differ slightly to the WHO's and UNICEF's, as they propose to introduce supplements "between the 5th and 7th month", and to continue BF "as long as the mother and child desire".[2]

I.3 Physiological considerations

The physiology of BF is complex, involving various aspects ranging from psychological factors to the function of the mammary epithelial cells.[20] The lactation process requires: i. An intact mammary gland (glandular tissue, ducts, innervation), ii. A functioning hormonal system (*i.e.* appropriate secretion of oestrogen, progesterone, prolactin, oxytocin, growth hormone, glucocorticoids), and iii. An efficient milk extraction process, depending on both ejection and stimulation (sucking, expressing).

Although insufficient breastmilk is a frequent concern for mothers and/or relatives, the inability to produce enough breastmilk under appropriate conditions remains uncommon.

I.4 Contraindications for breastfeeding

Absolute contraindications for BF are rare[9]:

- **Galactosemia** and **congenital lactase deficit** are not compatible with BF as they require a galactose-free or lactose-free diet.
- Mother's Human immunodeficiency virus (**HIV**) infection with a detectable viral load (in high-income countries).
- **Maternal drug intake**: most drugs are compatible with BF, but a few (E.g. some antineoplastic drugs, combination of several psychotropic drugs or certain antiepileptics), might justify interrupting BF, either temporarily or permanently *(see I.5).*

1.5 Precautions for breastfeeding

Precautions are necessary in the following situations:

- **Neonatal metabolic diseases: phenylketonuria** and **abetalipoproteinemia** are examples of diseases that might be compatible with some individually adapted amounts of breastmilk, combined with a special diet.
- **Transmission of infections**: various micro-organisms may be found in HM. For healthy term neonates, a few maternal infections require specific considerations:
  - **HIV** can be vertically transmitted through BF depending on the mother's viral load and immune status. Until recently, it has been one of the main contraindications in high-income countries. However, since 2018, the Swiss guidelines state that BF can be considered when the mother's viral load remains undetectable under sustained treatment and monitoring.[21–23]
  - **Hepatitis B** is not a contraindication for BF, once infants whose mothers present HBs antigens or anti-HBc-only status have received active and passive vaccination.[24]
  - **Hepatitis C** is compatible with BF, independently of viremia.[25]
  - Maternal **active tuberculosis, herpetic lesions on the breast(s), or active chickenpox** may require temporary discontinuation of BF.
  - **COVID-19 / SARS-CoV-2** is compatible with BF, which could even be protective for infants by antibody transfer. Infected mothers should take extra precautions, in the form of handwashing and wearing a mask to avoid spreading the virus to the infant.[26,27]
- **Risk of contamination with xenobiotic agents:**

- **Medications:** Maternal treatments are common causes of concerns and may lead to unnecessary weaning. Before prescribing any medication to BF mothers, physicians have to assess and discuss the expected benefits and risks. Although most drugs pass into HM, the proportion of drug transferred to the breastfed infant (*relative infant dose, RID*) is commonly low (<1%).[28,29] For most substances, benefits of BF outweigh the risks, and BF can be continued, after informed maternal consent. Precautions might be indicated, such as taking the medication straight after nursing when taking short half-life medications.[29,30] As quality data are scarce, and manufacturers' instructions often restrictive, it is important to consult reliable sources that collect and provide updated information. [https://www.embryotox.de (Germany), https://www.lecrat.fr (France), https://www.cdc.gov/breastfeeding/index.htm (USA)] When in doubt or in complex situations, the Swiss Teratogen Information Service [STIS, http://www.swisstis.ch/] can be consulted and/or specialized consultations can be indicated [for example, https://www.chuv.ch/fr/dfme/dfme-home/femme-mere/grossesse-accouchement/consultations-dobstetrique/grossesse-et-medicaments].
- **Smoking, alcohol and illicit drugs:** Parents and professionals frequently worry about smoking and drinking alcohol. BF can be an opportunity to reduce or stop such consumptions. However, if this is not the case, they should not be reasons to discontinue BF. In all cases, parents must maintain a smoke-free environment around the child. Alcoholic drinks are to be avoided or consumed only in small amounts, preferentially after nursing. Illicit drugs should not be consumed, and addictions need to be discussed and treated whenever possible.[31]
- **Environmental contaminants and pollutants:** This is a rising preoccupation, particularly regarding persistent organic pollutants or heavy metals passing into the milk.[32] Based on the current knowledge, we conclude that the benefits of breastfeeding outweigh its possible toxicological disadvantages. Nevertheless, politic, economic, scientific, and educational efforts are required to reduce the pollutants' environmental exposure.

I.6 Supporting breastfeeding around birth

Promoting, supporting and protecting BF require the involvement of the political, socio-cultural, educational and health care systems. Even though it is often considered as "natural", BF is indeed a complex process. Most mothers can breastfeed successfully if they are healthy and properly supported. However, some circumstances may interfere with their choice or impair BF success.[33,34] To take an informed decision and optimize their chance to successfully BF, women and families need to receive adequate and sufficient information and education during pregnancy, at birth and postnataly.[35–38]

The first days following birth are particularly critical for BF initiation and continuation. Perinatal health care professionals need to coherently coordinate and encourage measures that favour BF, while avoiding potentially adverse interventions (*see Table 2*).[39] The organisation of the maternity wards must offer appropriate conditions to promote, support and protect BF. Adherence to the 10 steps defined by Baby Friendly Initiative[40] appears for example to enhance early BF initiation after birth, exclusive BF and total BF duration.[41] *Table 2* presents examples of supportive measures that should be implemented. Moreover, personalised support and interventions may be necessary.

Table 2. Supporting breastfeeding in the maternity wards

Organisation

- All perinatal **health care professionals should be trained** to assist and assess BF issues.
- Ensure of information consistency and coordination between stakeholders: **written policies and instructions / information**, and/or other media (videos, applications, etc.).
- Respect of the International Code of Marketing of Breast-Milk Substitutes.[42]
- Systematic and structured documentation related to BF in the **patient records**.
- **Monitoring BF rates** as part as quality improvement and benchmarking process.

Resources

- **Professional BF support** (midwives, lactation consultants, nurses, obstetricians, and paediatricians, others).
- **Involvement of fathers/partners**, whenever feasible, as it appears to improve BF success and parental satisfaction.[43]
- "**Peer support**" system might be efficient and complementary. [44]

Practices

- Place the neonate **skin-to-skin** immediately after birth, encourage early BF (1st hour); postpone non-urgent care (e.g. weighing, measurements, bath).[45] Encourage frequent and prolonged skin-to-skin contact, as long as the mother is awake, well and alert.
- Facilitate the 24/24 hours **rooming-in** of the mother and child; avoid separation.
- Promote **exclusive BF, on demand / *ad libitum***; do not restrict the duration and/or frequency of feedings, nor administer systematic supplements.
- Observe and assure **appropriate positioning** when latching on and during BF (mouth wide-open, chin leading, tongue down) in order to promote efficient suction, optimal milk transfer, and to avoid pain or lesions of the nipples.
- **Discourage/delay the introduction of pacifiers during the initiation of BF**; as pacifiers could be protective against sudden infant death syndrome, they can be introduced once BF is well established (usually after 3-4 weeks).[9]
- Provide **appropriate parental information on the healthy neonate's physiology and behaviour**, signs of hunger/satiety, sleep and crying, etc.
- Consider colostrum hand expression or **milk expression** by hand or using a hospital grade milk pump when the neonate cannot suck efficiently.
- Early identification of **factors interfering with BF**[33,34] to provide timely and adapted support intervention, when appropriate, such as:
  - **Socio-cultural and economic factors**: E.g. low level of education, constraints and professional resumption, negative cultural or familial beliefs, social isolation, single-parent household.[46]
  - **Maternal conditions**: E.g. obesity, diabetes, smoking, extreme ages, chronic diseases, severe malnutrition, breast surgery or specific anatomy, hormonal disorder, stress or poor self-confidence.[11,47]
  - **Obstetrical/per-partum circumstances**: E.g. caesarean section, pregnancy or delivery complications, sore nipple, mastitis, tiredness, pain, primi-parity, multiple births.[48]

1.7 Assessing breastfeeding after birth

Assess (history, observation, examination) and report BF issues in the medical file *(see Table 3)*.

Table 3. Breastfeeding monitoring

Number of feedings	Variable, min. 4 the first 24 hours, then 8-12 / day
Feeding duration	Variable, 5-60 minutes
Feeding quality	Position, wakefulness, rhythm, swallowing, signs of satiety, relaxed breasts
Breast examination	Anatomy, tension, condition of the nipples
Urine in diapers	Min. 2/day on DOL 1-2, 3/day on DOL 3-4, 6/day from DOL 5
Stools	Min. 1 during the first 48h following birth (meconium), transitional stools from DOL 3; frequency (variable), quality, quantity, colour, texture
Infant examination	General condition, neurological examination, state of hydration, oral sphere
Neonatal weight	*See 1.8*

DOL: Day of life

1.8 Neonatal weight monitoring

Neonatal weight is traditionally used as an indicator of BF success, particularly in the first days of life (DOLs). However, the interpretation of weight should carefully integrate other indicators (*see Table 3*), taking into account the overall clinical situation, together with the dynamic physiological weight changes. The growth of breast-fed infants differs from that of formula-fed infants, and should be assessed according to appropriate standards.[49] Early weight loss nomograms have also been established and can be helpful when assessing postnatal weight loss.[50] In healthy term neonates, early postnatal weight loss occurs mainly due to physiologic diuresis of extracellular fluid and evacuation of meconium, with a mean loss of 4-9% of birthweight between DOLs 2-4.[51] Birthweight should be regained by DOLs 7-14 and weight gain should then be >150g/week. However, the kinetics and range of the physiological weight loss is variable and valid cut-offs are difficult to define. It has been shown for example that weight loss exceeds 10% of birthweight in 5% of vaginally delivered infants and up to 25% of caesarean delivered infants.[50,52] The proportion of weight loss increases with birthweight, so heavier neonates tend to lose proportionally more weight.[53] Excess neonatal weight loss can also be related to maternal intrapartum fluid balance (for example, intravenous fluid overload).[54] Some data suggest that breastfed healthy term infants could lose up to 12% of their birthweight without complications. Thus, weight loss >10% should not be interpreted as an indicator for supplementation by itself, but rather as an indicator for evaluation before considering supplementation.[8,55]

II. Breastfeeding supplementation and substitutes

II.1 When to supplement?

Prevention and treatment of hypoglycaemia are the main medical indications for early supplementation of BF**.** Most common conditions associated to an increased risk of hypoglycaemia are: preterm birth <37 weeks of gestation, maternal diabetes, birthweight at term <2500g (or <3rd percentile for gestational age) and >4500 g (or >97th percentile), or hypothermia <36.5°C. Further information on management of these situations is presented elsewhere.[1]

For healthy full term neonates, without risk factors nor signs of hypoglycaemia, BF supplements are generally unnecessary and can even be deleterious. Evidence suggests that supplementation using infant formula could affect the duration of BF, while its role in higher allergic risk is controversial.[8] Thus, the decision to supplement healthy term neonates must be well considered in situations associated to significant risk or discomfort to the infant and/or the parents (*see II.2*).

The following **indicators alert to consider supplementation** within the first days of life:

- Clinical signs of severe dehydration and/or hypernatremia
- Hypoglycaemia signs confirmed by blood measurement
- Inconsolable crying and irritability after BF without any other explanation
- Parental demand/distress/exhaustion, in case of failure of reassurance after appropriate professional information and assistance
- Weight loss >10-12% of birthweight, only after cautious assessment and interpretation (*see I.8*)

In all cases, decision to supplement should be **carefully assessed and adapted to difficulties faced by the mother and/or child** (*see Table 3*), and given after informed consent with the mother (or parent if the mother is unavailable). Furthermore, **additional measures to support BF** have to be enhanced**,** such as increasing

the frequency of breast stimulations, colostrum/milk expression, skin-to-skin, or positioning adaptations.[56]

II.2 What supplements?

When appropriate, supplements may be offered, with respect to their availability and parental preferences:

- Whenever possible, **expressed mothers' own milk (MOM)**, including antenatally expressed colostrum if available.[57]
- If the volume of mother's own milk does not meet infant requirements, it is possible to consider transiently **human donor milk (HDM)** if available from a milk bank.[8] However, HDM is not yet generally implemented in Switzerland and it is prioritized for at-risk (especially preterm) infants. On the contrary, informal HM sharing between mothers outside milk banks are discouraged as they present risks, mainly of infection transmission (e.g. HIV, hepatitis, pathogenic bacteria).[58]
- Infant formula is an appropriate alternative when HM is not available (*see II.5*).

Glucose or dextrose solutions (except dextrose gel for prevention or management of hypoglycaemia), **water or infusions are usually not appropriate** for healthy neonates as they do not provide adequate nutrition.

II.3 How to supplement and how much?

- Various **methods of providing supplementary feedings** are described, such as using a nursing device at breast, cup, spoon, dropper, finger, syringe or bottle, but there is currently no convincing evidence establishing the optimal method.[8] Thus, the choice of a specific method should be based rather on benefit: risk assessment depending on the experience and resources of the center and/or on specific needs of the infant and parental preferences.
- The **amount and frequency** of meals vary over time, weight and needs of each infant. It generally begins with frequent small quantities that progressively increase to reach around 130-160 mL/kg/day (about 1/6-1/7th of the infant's weight, providing approximately 100 kcal/kg/day) by the end of the 2nd week. In practice, the infant should be fed **on demand/*ad libitum*** (*i.e.* following signs of hunger/satiety, without defined schedules). The rhythm is usually established over several weeks, and changes constantly over the first months of life, with large individual variations (5-10 feedings per day). In the absence of studies on adequate amounts of feedings, the Academy of Breastfeeding Medicine (ABM) proposes indicative values for the first DOLs, based on reported volumes of colostrum *(see Table 4*).[8]

Table 4. Indicative volumes of feedings in the first days of life

DOL	Volumes
1	2-10 mL/feed
2	5-15 mL/feed
3	15-30 mL/feed
4	30-60 mL/feed

DOL: Day of life

II.4 Infant formula

When BF is impossible, undesired, or insufficient, infant formula constitutes an appropriate alternative to supplement or substitute it for healthy term neonates. Their composition, labelling, presentation, and advertising are subject to legal statements.[59] Infant formula is an industrial preparation mostly based on cow's milk, occasionally goat's milk or soy, which cover nutritional needs of the first 6 months.[2] By contrast,

homemade preparations are not appropriate at this age, as they might be nutritionally unsuitable and carry risks of contamination.

Considerations on certain formula

- The evidence is not sufficient to recommend **partial** ("hypoallergenic" or HA) nor **extensive hydrolysed formula** to supplement the neonates for the prevention of allergic disease, even those with a family history of allergic disease.[2,60,61]
- **Soy protein-based infant formula** may constitute an acceptable alternative to families that do not consume milk from animals (e.g. vegan diet).[62,63] They are yet not recommended in cow's milk protein allergy (risk of allergic cross-reaction).
- **Pre- and / or probiotics** enrich most infant formulas. For healthy term infants, however, these practices have not demonstrated clear clinical benefit.[64]

Preparation of infant formula

Hygiene and preparation instructions may vary among countries. The current national recommendations are summarised in *Table 5*.[2]

Table 5. Preparation of infant formula

Timing	Before immediate use
Cleaning	Careful cleaning, rinsing and drying of the bottle and the teat before each use. Boiling is not mandatory.
Storage	Dry and clean place
Dosage*	Carefully respect the ratio of powder to water indicated by the manufacturer
Water*	Fresh clean tap water is generally preferable to mineral water (in Switzerland).
Temperature	Powdered formula can be prepared with water heated to a suitable temperature, or with cooled boiled water. To avoid burns and denaturation of the content, formula must not be prepared with water at a temperature ≥70 °C nor heated in microwaves.

** For powdered formula*

III. Nutritional complements: Vitamins and mineral complements

III.1 Vitamin D

Vitamin D deficiency is common, particularly in Europe (mainly due to low exposure to the sun) and are associated with a low vitamin D content in breastmilk. In Switzerland, for example, a daily complementation of 400 IU/day (10 µg) is recommended during the first year of life.[65]

III.2 Vitamin K

The administration of 3 oral doses of vitamin K (e.g. Konakion MM® 2 mg) 4 hours after birth, on the 4th day and at the age of 4 weeks is recommended to prevent the risk of haemorrhagic disease of the neonate.[66]

III.3 Iodine and fluorine

The Swiss cooking salts are fortified with iodine (25 mg/kg, red packets) or iodine and fluoride (250 mg/kg, green packets). Pregnant and BF mothers should be advised to use these salts, rendering additional complementation for their infants unnecessary.[2]

III.4 Iron

For healthy term infants, the iron content of breastmilk is usually sufficient during the first 6 months of life. Late umbilical cord clamping(>1 minute after birth) may also help in reducing the risk of iron deficiency and anemia.[67] At risk neonates may have increased iron needs.[68]

III.5 Maternal complements in certain situations

General information on healthy and safe diet for pregnant and BF mothers are provided by the Swiss authorities.[69] Some women with **health problems affecting their nutritional status** (e.g. gastric by-pass, active Crohn's disease) and/or with **special diets** (e.g. vegan diets) require close nutritional management with the support from a nutritional health care provider to prevent deficiencies of different nutrients, especially the essential ones, which can be associated with further deficiencies in their milk.

Vegan mothers are particularly at risk for such deficiencies and must receive daily complementation during BF of up to 50 µg of **Vitamin B12**.[70] Moreover, deficiencies in Omega 3 fatty acids, iron, zinc, iodine and calcium are more frequent among vegan mothers and must be assessed. Daily intakes have then often to be complemented notably for **Omega 3 fatty acids** (200 mg of docosahexaenoic acid, DHA), **Calcium** (up to 1000 mg), **Vitamin D** (800 UI).

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