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Nutrition for Optimal Lactation

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Key Messages

- A healthy diet is essential to meet the additional energy and protein needs to support milk production and to improve nutrient density at this stage.
- Attention should be given to maternal omega-3 fatty acid intake, emphasizing the importance of eating fish or supplementation.
- In the postpartum period, iron supplementation is recommended to prevent anemia in high-risk regions.
- Vitamin D supplementation is needed to achieve adequate maternal status and prevent infant vitamin D deficiency; 4,000 IU/day may be needed.
- Counseling should be provided to improve breastfeeding initiation and continuation and promote optimal maternal and infant health.

Keywords

Breastfeeding · Nutrition status · Dietary intake

Abstract

Background: Breastfeeding is the ideal method of feeding for all newborns and is associated with multiple positive health outcomes. Human milk provides all essential nutrients and bioactive molecules needed for optimal infant health and development. Maternal nutrition during lactation plays an important role in supporting breastfeeding and in preventing nutrition and metabolic imbalances. The aim of this narrative review was to describe the most prevalent nutrition issues in lactating women and provide a summary of current diet recommendations as well as controversies on supplementation, in order to facilitate the information for clinicians and health professionals. ***Summary:*** Breastfeeding is a nutritionally demanding stage and adequate nutrition is key to avoid alterations in maternal nutritional status, to produce an adequate quantity of milk with good quality, and to avoid nutrition programming of diseases. Anemia and vitamin D, A, iodine, and iron deficiencies are common, while obesity and metabolic diseases keep rising. Inadequate maternal intake of many nutrients is also frequent in this stage.

Introduction

Breastfeeding is the ideal method of feeding for all newborns. The World Health Organization (WHO) recommends exclusive breastfeeding (EBF) for all infants during the first 6 months of life and, if possible, breastfeeding should continue to at least 2 years of age [1]. Human milk is the primary source of nutrients, immunologically active molecules, appetite-regulating hormones, and other bioactive compounds essential for optimal infant growth and development. Human milk meets an infant's nutrient needs during the first 6 months of life. It is also a source of a wide variety of bacteria that colonizes the infant's gut and promotes the proliferation of beneficial bacteria [2, 3]. Fermentation of human milk oligosaccharides (HMOs) in the colon, mainly by bifidobacteria, generates multiple metabolite products that have been associated with adequate gut barrier development, epigenetic modifications in enterocytes and other cells, and regulation of antigen tolerance [4, 5].

Breastfeeding is associated with multiple positive health outcomes for the mother and the infant. Short-term maternal health benefits include lower risk of hemorrhage after delivery,

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lower stress, delay of ovulation, lower blood pressure, and reduced risk of postpartum depression. Breastfeeding mothers show a higher postpartum weight loss and a higher probability of achieving their prepregnancy weight. Long-term epidemiological studies have documented a reduced risk of obesity, some cancers, hypertension, and type 2 diabetes [6].

The Global Breastfeeding Collective aims to achieve 70% of newborns initiating breastfeeding within 1 h of birth, 80% of women continuing breastfeeding for 1 year, and 60% continuing for 2 years [7]. A 2021 Lancet analysis of breastfeeding trends in 113 countries between 2000 and 2019 showed that only 47% of newborns start breastfeeding within 1 h of birth. An increase from 35% to 49% in EBF at <6 months from 2000 to 2019 was observed in low- and middle-income countries (LMICs). All regions showed increasing trends in EBF, except the Middle East region and North Africa. In 2019, 81.1% of infants continued to receive any breastfeeding at 1 year of age, with an increase in high- and middle-income countries and a decrease in low-income countries [8]. In addition, formula consumption has increased globally [9]. Formula feeding has been associated with differences in microbial diversity, lower and suboptimal gastrointestinal adaptation, and higher infection and hospitalization rates [4].

The Global Breastfeeding Collective aims to achieve 70% of newborns initiating breastfeeding within 1 h of birth, 80% of women continuing breastfeeding for 1 year, and 60% continuing for 2 years

Low-income, less educated, and young women are less likely to start and maintain breastfeeding. Barriers such as lack of practical support, perception of inadequate quantity of milk, high promotion and distribution of human milk substitutes, societal attitudes, lack of support in the workplace, lack or inadequate duration of paid maternity leave, and low breastfeeding self-efficacy have been reported frequently [9].

Worldwide efforts have been implemented to promote and support breastfeeding. Countries that have successfully increased breastfeeding practices have implemented multiple interventions, including the Code of Marketing of Breastmilk Substitutes, breastfeeding counseling, and different regulations to improve women's maternity leave periods and working conditions [8]. This paper will describe the main nutrition and metabolic challenges that lactating women are experiencing and will present a summary of the main nutrition recommendations, considering guidelines and published systematic and narrative reviews from studies on lactating women.

Nutrition and Metabolic Challenges in Lactating Women

Optimal women's nutrition should be promoted across the whole reproductive cycle. Globally, two main nutrition challenges for women include preventing nutrient deficiencies and preventing obesity and metabolic diseases. Breastfeeding is a highly demanding physiological stage, characterized by high energy and nutrient requirements. However, in many countries, unhealthy diets providing excessive intakes of energy, fat, saturated fat, added sugars, and with low nutrient density and fiber are frequently consumed and have been considered risk factors for multiple chronic diseases [10]. Controversial data from reviews of studies exists in breastfeeding women. On the one hand, lower quality diets have been reported, when compared to pregnant women [11, 12], and in the other adequate intakes for energy, carbohydrates, and many nutrients [13]. Globally, studies have shown a high prevalence of inadequate omega-3 fatty acid intake, including docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). Only countries with high fish and seafood intakes appear to meet intake recommendations; for most regions, the DHA intake is lower than 100 mg/day, compared to a target of 200–450 mg/day [14]. Excessive intake of omega-6 fatty acids is frequently observed in women from Western countries, probably resulting in lower omega-3 fatty acids availability and higher inflammatory profiles [12]. Low intake of DHA has been reported in lactating women, and different reviews of studies have shown an association between maternal intake of DHA and breast milk content [11]. A high prevalence of low micronutrient intake and deficiencies in lactating women has also been reported in South-East Asia and Hispanic populations [15, 16]. The leading cause of multiple micronutrient deficiencies is a poor-quality maternal diet. Inadequate intake of animal protein in developing countries or high prevalence of vegetarian/vegan diets in high-income countries are associated with lower micronutrient intakes in pregnancy and lactation [12]. A high intake of phytates or polyphenols is also typical in vegetarian/vegan diets (legumes and unrefined grains), affecting the absorption of some nutrients. The micronutrients that are more frequently consumed below the recommended intakes are vitamin A, vitamin D,

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folate, vitamin B1, vitamin B6, calcium, zinc, potassium, and selenium, which may result in developing nutrient deficiencies [12, 17, 18]. Breast milk content of some B-complex vitamins (thiamin, riboflavin, vitamin B6, and vitamin B12), vitamin A, vitamin D, vitamin E, iodine, and selenium represent the primary source for the infant and appear to be dependent on the maternal diet or status of these vitamins. Maternal dietary intake or nutrition status of folate, calcium, iron, copper, and zinc do not appear to influence breast milk concentration of these nutrients [12]. A 2024 systematic review (27 observational studies, 7 intervention studies) corroborated the positive association between maternal fish and long-chain polyunsaturated fatty acics (LCPUFAs) intake with breast milk concentration of these fatty acids and particularly DHA and EPA. The evidence regarding other nutrients was highly variable and the observed methodological limitations in the studies (time of postpartum, sampling techniques, low quality) did not allow to draw strong conclusions [11].

Anemia is still a significant health problem, and women of reproductive age are particularly vulnerable. Higher levels of food insecurity, low iron intake, gynecological disorders, and maternal hemorrhage are the main determinants of anemia in these women [19]. Studies from high-income countries have reported 10–30% prevalence of postpartum anemia; higher numbers are expected in LMICs [20]. Iron, iodine, vitamin A, and vitamin D deficiencies are still highly prevalent worldwide and primarily affect women and individuals from LMICs [21, 22]. A high prevalence of vitamin D deficiency has been reported in breastfeeding women from different countries (Mexico: 62%, United Arab Emirates: 61%, China: 52%, India: 48%, Turkey: 46%). Low sun exposure and low dietary intake are the main factors associated with low serum vitamin D concentrations [23].

Iron, iodine, vitamin A, and vitamin D deficiencies are still highly prevalent worldwide

On the other hand, the number of women of reproductive age who are overweight, have obesity or other metabolic diseases continues to increase around the world. Starting pregnancy with obesity increases the risk of adverse maternal, fetal, and neonatal outcomes [24], as well as the risk of fetal metabolic programming of metabolic diseases and altered neurodevelopment later in life. Maternal obesity is also associated with lower EBF initiation and early cessation [25]. Barriers include lower breast milk production (lower prolactin response), a self-perception of low milk production, an early dyad separation, higher societal barriers, and mechanical issues [26, 27]. In addition, a high pregestational body mass index ($\geq$25 and $\geq$30) is associated with more frequent excessive gestational weight gain [28]. A meta-analysis of observational studies showed that higher gestational weight gain increased maternal body weight in the short and long term after childbirth [29]. Postpartum weight retention is a strong risk factor for developing obesity later in life, particularly in young, poor, and less educated women.

Dietary Intake Recommendations during Lactation

Energy Requirements

Energy expenditure during lactation is increased depending on the intensity and duration of breastfeeding. The estimated energy requirements for lactating women are based on rates of total energy expenditure, milk energy output, efficiency of milk production, and energy mobilization from stores. Total energy expenditure (TEE) may be estimated with validated prediction equations for adult women (nonpregnant, non-lactating), considering that no differences in TEE have been observed in lactation [30]. Recent recommendations from the National Academy of Sciences (USA) established that for breastfeeding women from 0 to 6 months, an additional 404 kcal/day are required, considering the average net cost of milk production to support an average milk volume of 808 g/day and an expected weight loss of 0.64 kg/month. In the second 6 months postpartum, weight changes are variable depending on the amount of milk produced, complementary feeding, maternal food intake, and physical activity. With a stable weight, an extra 380 kcal/day are required to support a milk production of 570 g/day. In the second year of lactation, the energy cost of milk production is variable and is dependent on multiple maternal and infant variables [30].

The European Food Safety Authority (EFSA) established an additional average energy requirement of 500 kcal/day for exclusively breastfeeding women during the first 6 months postpartum, compared to the prepregnancy energy requirement. They considered an energy cost for milk production of 670 kcal/day and an energy mobilization of 170 kcal/day [31].

Protein Requirements

Protein content in human milk does not appear to rely on maternal amino acid intake or body composition. Intakes of 1 g/kg/day appear to promote the conservation of skeletal muscle and maintain good milk production. According to the

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Institute of Medicine, and considering the output of total protein and nonprotein nitrogen in human milk, the additional protein intake during lactation for all age-groups is +25 g/day, corresponding to 1.3 g/kg/day [32].

The German Nutrition Society (2019) proposed a slightly different protein intake recommendation for EBF women. They stated that a 21–23 g/day increase is recommended during the first 6 months of lactation and 14 g/day afterward, if breast milk is a considerable proportion of the infant's diet. The average protein content of breast milk, already corrected for nonprotein nitrogen, has been estimated to be 1.36 g/100 mL in the first month and 1.17 g/100 mL in the second and third month postpartum. Assuming a volume of 750 mL/day, approximately 8.8 g of protein is secreted daily [33].

Fat Recommended Intake

There is no specific fat intake recommendation for breastfeeding women. In adults, 20–35% of total caloric intake should be provided by total fats and lower than 10% by saturated fat [31, 32]. According to a review of studies and reviews of studies in lactating women, an imbalance in the intake of lipids is frequent. The most common profile was high saturated fat and omega-6 fatty acid intake and low intake of omega-3 fatty acids and DHA. Omega-3 fatty acids are precursors of anti-inflammatory eicosanoids, and high omega-6 may impair omega-3 bioavailability. A high omega-6/omega-3 intake ratio promotes inflammation and may increase risk of chronic diseases associated with inflammation [12].

Breast milk content of LCPUFAs is dependent on the quantity in the maternal diet and their biosynthesis from precursor activity. Omega-3 fatty acids play an essential role in visual and neurological infant development and are an integral part of the brain and retina. A high amount of DHA is provided to the fetus and infant from the second half of pregnancy and to the first 18 months of life. Infants obtain most DHA from breast milk or formula. LCPUFA in breast milk remains stable during the first year of life; lower concentrations are observed in low fish diet regions [34, 35]. General intake recommendations for lactating women include consuming 1.3 g/day of alpha-linolenic acid and approximately 200–450 mg/day of DHA (an additional 100–200 mg/day) [31, 36, 37]. Even though alpha-linolenic acid in the diet may convert to DHA, its limited metabolic conversion does not allow for an adequate DHA status without direct food DHA sources [38].

Women with low intakes of fatty fish may need a dietary supplement to improve omega-3 fatty acid content in breast milk, particularly DHA. According to a meta-analysis of 65 studies done around the world, the average content of DHA in breast milk was 0.32% (34). In a small controlled feeding and supplementation study in 27 lactating women (5 weeks), a standard dose of 200 mg/day of DHA did not increase maternal red blood cell DHA, but a significant increase in breast milk percentage of DHA was observed. Baseline percentage of DHA in breast milk was 0.19%, and the proportion of women achieving a level of 0.32% increased significantly from 30% to 56%. The increase was higher in women with lower baseline DHA concentrations [39]. According to a recent umbrella review of 28 meta-analyses of RCTs, omega-3 supplementation during pregnancy and lactation showed a favorable effect on postnatal length (1–7 years, 9 RCTs), with moderate quality evidence, and an increase in fat mass and waist circumference. A positive effect was observed in offspring immunity, and a lower risk of perinatal and postpartum depression was observed (low-quality evidence) [40]. Omega-3 LCPUFA during pregnancy and continuing lactation probably reduces the risk of asthma/wheezing, according to another meta-analysis [41]. A Cochrane review reported that there is no conclusive evidence about LCPUFA supplementation in lactation and improvement in neurodevelopment or visual acuity in children [42].

Carbohydrate Recommended Intake

For lactating women, the minimal intake of carbohydrates is 210 g/day, and the recommended fiber intake is 29 g/day [32]. The quantity and type of carbohydrates are two factors to consider, avoiding both extremes in intake and promoting healthy carbohydrates in the diet (high fiber and low glycemic index foods). Dietary fiber, polyphenols, and monounsaturated fat are the nutrients that have the most influence on the breast milk content of HMOs, which are nondigestible carbohydrates representing 94–96% of total human milk complex carbohydrates. Intake of HMOs is positively associated with brain development, immune system maturation, and regulation of gut microbiota composition [43].

Recommended intakes for some vitamins and minerals are higher during lactation than in pregnancy

Relevant Vitamin and Mineral Recommended Intakes

Maternal micronutrient intake is essential to support multiple metabolic processes, oxygen transportation, DNA synthesis, antioxidant defense, and anabolic function, which are required for optimal infant immunity, growth, and neurodevelopment. Recommended intakes for some vitamins and minerals are higher during lactation than in pregnancy (Table 1). Food sources of relevant vitamins and minerals are shown in Table 2.

Table 1. Micronutrient intake recommendations for breastfeeding women by different associations

	Lactation			Adult women[1]
Nutrient	WHO/FAO [44]	EFSA [31]	IOM/NAS [32, 45]	IOM/NAS [32, 45]
Vitamin D, IU/day	200[2]	600[3]	600[4]	600[4]
Vitamin A, µg/day	850[5]	1,300[2]	1,300[2]	700[2]
Vitamin E, mg/day	NA	11[4]	19[2]	15[2]
Folate, µg/day	500[2]	500[2]	500[2]	400[2]
Vitamin B12, µg/day	2.8[2]	5.0[4]	2.8	2.4[2]
Vitamin B6, mg/day	2.0[2]	1.7[2]	2.0[2]	1.3[2]
Vitamin C, mg/day	70[2]	155[2]	120[2]	75[2]
Calcium, mg/day	1,000[2]	950–1,000[2]	1,000[4]	1,000[4]
Iron, mg/day	10–30[6]	16[2]	9[2]	18[2]
Iodine, µg/day	200[2]	200[4]	290[2]	150[2]
Magnesium, mg/day	270[2]	300[4]	310–320[2]	310[2]
Selenium, µg/day	35–42[2]	85[4]	70[2]	55[2]
Zinc, mg/day	4.3–19[2,6]	+2.9[2]	12[1]	8[2]

[1]Nonpregnant, non-lactating. [2]Recommended nutrient intake/recommended dietary allowance/population reference intake. [3]In minimal cutaneous vitamin D synthesis. [4]AI, adequate intake. [5]Recommended safe intake. [6]Depending on bioavailability.

Folate and Other B-Complex Vitamins

Folate, B2, B6, and B12 vitamins participate in one-carbon cycle metabolism and are essential for DNA methylation. The daily recommended intake of folate is 500 µg/day, which is lower than the pregnancy recommendation (Table 1). Maternal blood folate concentrations decline during lactation, affecting maternal folate status. Higher concentrations of 5-methyltetrahydrofolate (active form) in breast milk are associated with lower 5-methyltetrahydrofolate in maternal plasma, suggesting maternal depletion of folate [46]. Routine folate supplementation is not generally recommended during breastfeeding. The WHO recommends iron and 400 µg/day of folic acid during 6–12 weeks postpartum to decrease the risk of anemia, in settings with high prevalence [20]. As in any other population, if dietary intake is low, supplementation may be advisable to meet intake recommendation. Supplementation in lactating women has been associated with higher red blood cell folate and possibly higher serum and plasma folate. However, maternal status does not appear to influence folate levels in human milk (moderate quality evidence) [47]. When supplementing postpartum women, caution should be used when continuing prenatal folic acid supplements because this may exceed the tolerable upper intake of this nutrient (1,000 µg/day), considering the high amounts of folic acid that some of these supplements may have.

Adequate maternal intake of vitamin B12 is essential in this stage. Women following a vegan or plant-based diet are susceptible to deficient dietary vitamin B12 and may need supplementation. Low supply of vitamin B12 has been documented in EBF infants, and inadequate infant B12 status is associated with severe neurological symptoms [48]. The recommended intake of vitamin B6 for lactating women is 1.3 mg/day to ensure adequate vitamin B6 status [49]. Vitamin B6 intake in exclusively breastfeeding women is a significant predictor of infant B6 status. Plasma pyridoxal 5′ phosphate, the active form of vitamin B6, is 50% lower in EBF infants, and its concentration decreases with more months of EBF [50].

Vitamin D

Breast milk vitamin D content is generally low, and it increases with higher maternal intake and better maternal vitamin D status [12, 51]. Milk content of vitamin D will be low if a woman experienced vitamin D deficiency during pregnancy. Thus, maintaining adequate maternal vitamin D status is important to prevent infant vitamin D deficiency and rickets [52]. It may be difficult for a mother to achieve adequate vitamin D status with low sun exposure and low consumption of diet sources. Factors that increase the risk of maternal vitamin D deficiency include low solar radiation, autumn/winter seasons, high latitude regions, obesity, and dark skin pigmentation. Recommended intake of vitamin D during lactation range from 200 to 600 IU/day (Table 1). An upper tolerable intake of vitamin D has been set at 4,000 IU/day. However, this number has been controversial, considering doses of up to 10,000 IU/day are not related to toxicity. The US Endocrine Society recommends a

Table 2. Food sources of relevant nutrients and individual factors to consider supplementation during lactation

Nutrient	Main food sources	Reported benefits	Doses	Factors to consider
Omega-3 fatty acids (DHA, EPA)	Oily fish, seafood, fish oil Flaxseed, nuts, seeds (alpha-linolenic)	Adequate maternal and infant DHA status May increase infant length, waist, fat mass; improve immunity May decrease postpartum depression	Minimum 250 mg DHA	Low fish and seafood intake
Vitamin D	Cod liver oil, fish (salmon, tuna, sardines, swordfish) Beef liver, egg yolk Fortified dairy	Adequate maternal and vitamin D infant status	Controversial 1,500 IU/day to >4,000 IU/day	Most breastfeeding women need supplementation
Iron	Meat, poultry, fish, seafood Organ meats, eggs Legumes Spinach, dark green leafy greens, sweet potato, peas, beets, broccoli	Adequate maternal iron status Prevent and/or treat maternal iron deficiency anemia	*Postpartum*: 27–30 mg/day *Anemia*: 120 mg/day with 400 µg/day folic acid *Otherwise:* individualized	All postpartum women (for 6–12 weeks) in high anemia regions (WHO) Iron deficiency anemia or high risk; low iron intake; vegan or plant-based diets; food insecurity
Folic acid	Dark green leafy vegetables, beans, peas, peanuts, sunflower seeds Fresh fruits Liver	Adequate maternal folate status	400-500 µg/day	Low folate intake; food insecurity; low fortification strategies
Iodine	Fish, shellfish, seaweed Table salt (iodized) Dairy, eggs	Adequate iodine status; may prevent infant iodine deficiency	150 µg/day	Low iodine sources; lack of salt fortification
Vitamin B12	Beef, animal liver Fish (sardines, tuna, salmon, trout), clams Dairy Fortified plant "milk"	Adequate B12 status; may prevent infant B12 deficiency	To meet 100% recommended intake	Vegan diet; plant-based diets
Calcium	Dairy (milk, cheese, yogurt) Fortified plant-based "milks" Sardines, salmon (with bones) Soybeans, tofu, winter squash	Adequate maternal calcium status	To meet 100% recommended intake	Low dairy intake or dairy-free diets; low calcium intake areas
Zinc	Seafood (oysters, crab) Beef Fish (salmon, sardines) Oats, pumpkin seeds Milk, cheese	Adequate maternal zinc status	To meet 100% recommended intake	Vegan diet; plant-based diets High phytate intake Malabsorption
Multiple micronutrients	–	Very few studies	To meet approximately 100% recommended intake	Low nutrient diets; food insecurity; vulnerable groups

daily dose of 1,500–2,000 IU/day for breastfeeding mothers to meet their own needs but states that women may need 4,000–6,000 IU/day to meet the needs of their infants [53]. A recent review of vitamin D supplementation in breastfeeding women (6 studies) showed that most infants (90%) in the group supplemented with ≥4,000 IU/day had adequate vitamin D status [54].

Iron

The recommended iron intake during the lactation period is 9–10 mg/day [32], which is significantly lower than nonpregnant, non-lactating women (because lactating women are generally amenorrheic and conserve iron that otherwise is lost in menstruation). However, the recommendation may be up to 30 mg/day in low bioavailability situations [31]. In addition, iron breast milk concentrations are low and are not influenced by maternal iron status or intake. However, it is common to observe low body iron stores in the postpartum period [55]. The WHO recommends iron and folic acid supplementation in postpartum women for 6–12 weeks after delivery in women from areas where anemia is a public health problem (prevalences ≥20%). Doses may be the same as in pregnancy. In case of anemia, 120 mg/day of iron and 400 μg/day of folic acid should be supplemented [20]. Screening for anemia risk or iron deficiency anemia will help clinicians decide about iron supplementation during lactation.

Calcium

The recommended calcium intake for lactating women is 1,000 mg/day [32], which is the same as in adult women and during pregnancy. Some experts have questioned whether this recommendation is enough to meet the reproductive demands for a future pregnancy after 1 year postpartum. Approximately 300–400 mg of maternal calcium is lost through breast milk daily, associated with a temporary demineralization [56]. Evidence from different reviews of studies has not found a clear association between maternal calcium intake and calcium content in breast milk [11, 12]. However, a low intake may result in a higher rate of maternal bone resorption [57].

Approximately 300–400 mg of maternal calcium is lost through breast milk daily

Iodine

Iodine is essential for developing the infant's brain, nervous system, and mental abilities. During breastfeeding, iodine requirements remain elevated to accommodate changes in maternal thyroid metabolism and because iodine concentrates in the mammary gland for excretion in the breast milk. Breast milk iodine content is dependent on maternal dietary intake and status [58]. Iodine supplementation is recommended in areas with low iodine sources or without universal salt fortification programs. A Cochrane review (n = 3 RCTs) documented that iodine supplementation (alone or in combination with other vitamins or minerals) in postpartum women decreased the risk of hyperthyroidism after giving birth when compared to women who took placebo or other vitamins/minerals (low-quality evidence) [59].

Zinc

An adequate supply of zinc is essential for infant growth. Colostrum has almost 17 times higher concentrations of zinc than blood, probably as an adaptative mechanism to compensate the low absorption of zinc from breast milk (approximately 50%). In addition, zinc milk content decreases while breastfeeding progresses. Therefore, the intake recommendation notably suggest a 50% rise relative to nonpregnant, non-lactating women. A zinc intake of 13 mg/day appears adequate, considering higher intakes do not result in higher breast milk concentrations [60]. With low bioavailability of zinc (i.e., high intake of phytates, copper, iron; malabsorption disorders), lactating women may need up to 19 mg/day at 0–3 months and 17.5 mg/day at 3–6 months [44].

Multiple Micronutrient Supplementation

Multiple micronutrient supplementation has been scarcely studied in lactation. A Cochrane review found no conclusive evidence that supplementing ≥3 micronutrients in breastfeeding mothers affects the mother or baby's health compared to women supplemented with two or fewer micronutrients. Only two studies were included, and they were of limited quality, with small sample sizes and limited reported outcomes [61].

Due to limited studies and inconsistencies in current evidence, it is not easy to decide when to start supplementation during this period. Table 2 shows factors to consider for individualizing maternal nutrient supplementation.

Dietary Patterns in Breastfeeding Women

As for the general population, a healthy dietary pattern is considered one with a high content of fruits, vegetables, grains, and legumes. It includes fish, dairy, eggs, and healthy fats (i.e., nuts and seeds, olive oil/other oils, avocado, and other monounsaturated fat sources) and limits red meat, processed meats, added sugars, and ultra-processed foods. This type of diet is

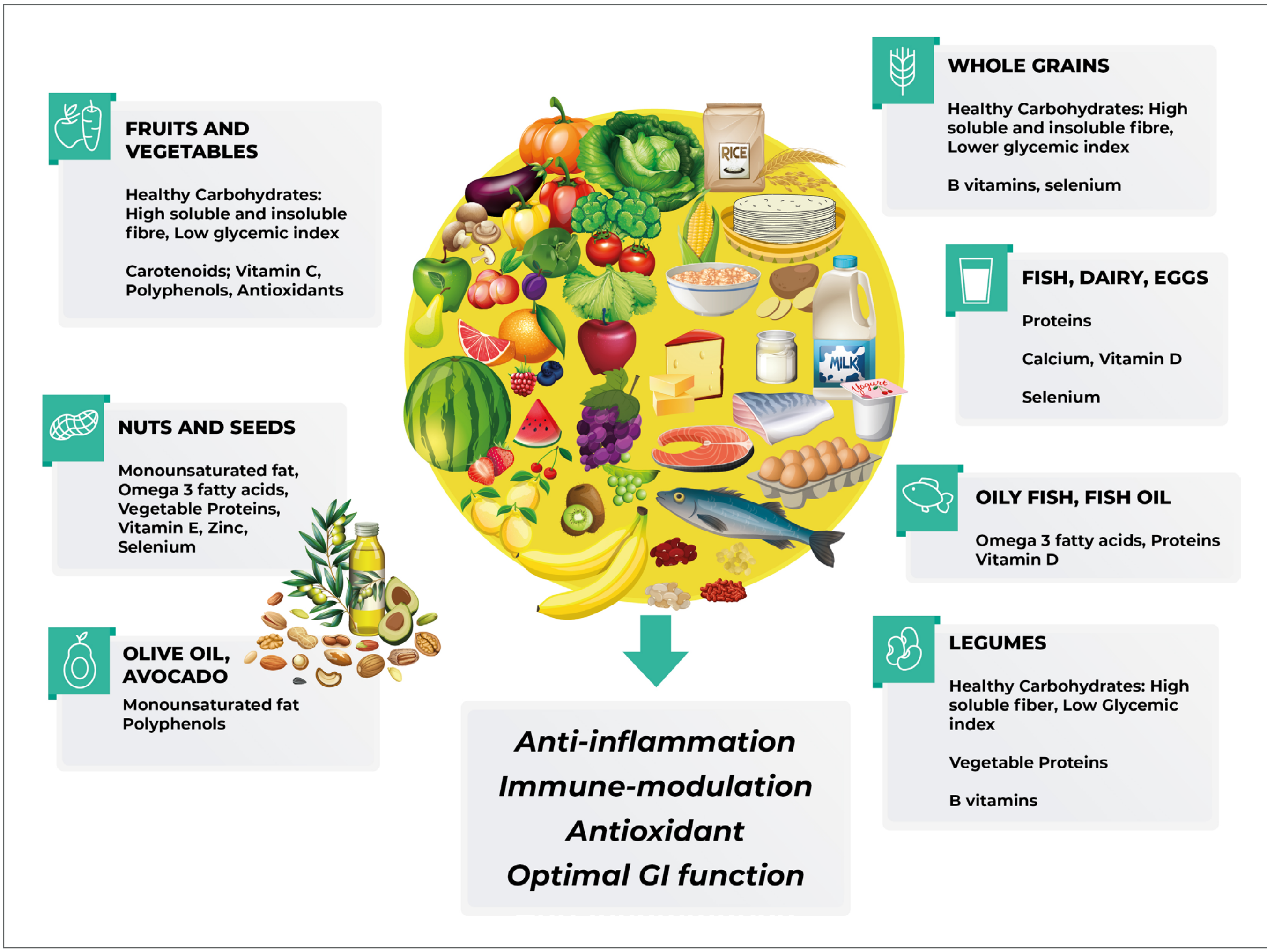

Fig. 1. Healthy dietary pattern and important nutrients (adapted with permission from Perichart-Perera [62]).

nutrient dense and, with an adequate variety of foods, it generally contains all the macronutrients and micronutrients to meet maternal requirements (Fig. 1). Essential components of a healthy dietary pattern, such as the Dietary Approaches to Stop Hypertension diet and the Mediterranean type, promotes the intake of fresh and minimally processed foods, and include a high content of healthy carbohydrates, with lower glycemic index and higher content of fiber, a high content of antioxidants and polyphenols, and a good amount of healthy fats, including monounsaturated and omega-3 polyunsaturated fatty acids sources. To meet the recommendation of DHA, women should eat 8–12 oz per week of oily fish or seafood, where possible.

Results from an observational cohort (MEDIDIET study) in 300 Italian women showed that higher adherence to the Mediterranean-type dietary pattern was associated with vitamin intakes at a level near to the recommendations and with lower postpartum weight retention at 2 and 6 months postpartum [13]; however, lower intakes of vitamin D and calcium have been reported [12, 13]. Women with high adherence to a Dietary Approaches to Stop Hypertension diet had higher breast milk content of calcium and antioxidant metabolites and lower content of lipid peroxidation products and triglycerides [63]. Women who follow a strict vegan diet are at risk of deficient intakes of vitamin B12, iron, calcium, zinc, selenium, DHA/EPA, iodine, and vitamin D and may need supplementation.

Regarding food allergen avoidance in the maternal diet during pregnancy and lactation, different national and international guidelines do not recommend excluding these foods (cow milk, wheat, peanuts) while breastfeeding to prevent food allergies or allergic diseases in the child, considering the lack of evidence of an association [64, 65]. More studies are needed to evaluate specific maternal dietary patterns during lactation and their effect on postpartum weight loss, human milk volume, infant nutritional status, allergies, asthma, and neurodevelopment.

Use of Other Substances

Other substances, such as caffeine and galactagogues, are commonly used during lactation. Some associations and guidelines recommend a maximum daily intake of caffeine of up to 300 mg/day for breastfeeding women (approximately 3 cups of coffee) [66].

Natural or pharmacological galactagogues are widely used by breastfeeding women in the belief that they increase milk production. According to a 2020 Cochrane review, the most frequent studied natural substances include moringa leaves, fennel, fenugreek, ginger, botanical teas, palm dates, and blessed thistle. Pharmacological galactagogues (domperidone, metoclopramide) may increase milk volume production, and there is some evidence about a possible beneficial effect of natural galactagogues on milk volume in healthy term infants (low-quality evidence). No clear evidence exists on breastfeeding continuation. However, these studies have a high level of uncertainty, considering differences in the type of products, timing of consumption, and lack of standardized outcomes [67].

Probiotic use during pregnancy and lactation has been controversial. A recent meta-analysis of studies showed that probiotic supplements (*Lactobacillus*, *Bifidobacterium*, *Streptococcus thermophiles*, and *S. boulardi*) increased beneficial bacteria in breast milk and infant gut, with some infant health benefits (modulation of growth and lower colic) [68]. Low certainty evidence exists showing that probiotic supplementation in breastfeeding mothers may reduce the risk of eczema but no other allergies [69].

Counseling for Breastfeeding Mothers

The postpartum period represents a challenge for most women, and it is the time to initiate and achieve a successful breastfeeding process. It also opens a window of opportunity to improve dietary and lifestyle behaviors to promote optimal maternal nutrition and metabolic status. Counseling aiming to increase knowledge and skills to facilitate breastfeeding and to improve lifestyle behaviors is highly recommended in societies where breastfeeding is not the cultural norm.

The WHO guidelines state that breastfeeding counseling should be provided to all pregnant women and mothers of young children, starting prenatally and postnatally up to 24 months or longer (moderate quality evidence). Counseling should be provided face to face, but remote counseling may also be used. A minimum of six visits may be necessary [70]. Training health professionals to develop counseling competencies is often challenging due to limited inclusion of nutrition topics in the formal education of medical doctors and other professionals. Pediatricians play an essential role in supporting breastfeeding, starting within the first hours of life, and in timely referring women to local and regional support groups. In 2021, only 28% of countries reported counseling activities among 75% of caregivers [7].

According to a recent Cochrane review of studies (103 studies), breastfeeding support interventions probably reduce the probability of discontinuing breastfeeding and EBF at any point and at 6 months. Moderate support (4–8 visits) may be more effective in preventing the discontinuation of EBF at 4–6 weeks and at 6 months [71].

Conclusions

Breastfeeding women have heightened nutrient requirements and may experience metabolic and nutritional challenges since preconception that may affect breastfeeding, nutrient composition of breast milk, and maternal and infant nutritional status. A thorough nutrition assessment is required to promptly identify and address nutritional deficiencies, prevent excess weight retention and metabolic complications, and ensure optimal support for successful breastfeeding. Advocating for promoting a healthy dietary pattern, universally accessible to all breastfeeding women, is essential for optimal maternal and infant health.

Conflict of Interest Statement

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Author Contributions

Dr. Otilia Perichart-Perera is the sole author of this manuscript.

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