Issue 2, 2017

Women's Health
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Women'sHealthREPORT
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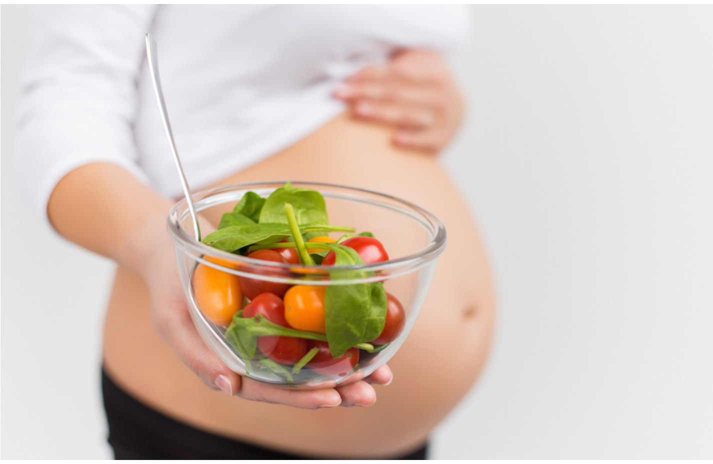
LACTATION AND GESTATIONAL NUTRITION: Considerations for the RDN

By Miriam Erick, MS, RDN, CDE



This article is approved for 1 CPEU by the Commission on Dietetic Registration, the credentialing agency of the Academy of Nutrition and Dietetics. Upon reading this article, please take the quiz at http://bit.ly/2nQCQ3i. To learn more about the author, see the Member Spotlight on page 8.

Learning objectives:

1. Identify at least three nutrients which may require supplementation in term infants of breastfeeding mothers
2. List at least two situations when vitamin B12 supple menta-tion may be recommended
3. Explain why a neonate might suffer a nutrient deficiency while the mother appears healthy

Human milk, the preferred nourishment for a neonate, may be best thought of as the product of nutritional choices of the mother. This starts with general lifestyle and dietary habits at preconception, continuing through conception, pregnancy, the postpartum period, and lactation. Dietary choices and/or medical situations during each of these stages can affect the nutritional profile of human milk. Foods, medications and herbs transferred to the infant via the placenta have a lasting impact on child health.

It is not known who first coined the phrase "breast milk is the perfect food for the infant," but it is widely prevalent in the literature. Breastfeeding is the biological norm for all mammals. While breast milk is highly nutritive and contains important immunological and growth factors that cannot be replicated in breast milk substitutes, scientific investigation reveals a few shortfalls. Overall, human breast milk of some women in the U.S. has been found to be low in vitamin D,[1,2] iodine,[3] iron,[4, 5, 6] and vitamin K.[7, 8] Given these findings, it might be more accurate to describe breast milk as "conditionally perfect", however it is essential to take an individualized approach when working with pregnant and lactating mothers to identify risk factors for possible nutrient deficiencies. The focus of this paper is to explore some of the available data and highlight areas of potential consideration for the RDN (Table 1).

in this issue

Table 1: Lifestyle Factors and Possible Impact on Lactation

	Preconception	Pregnancy	Postpartum
Eating disorders (e.g., anorexia nervosa)[47,48]	Planning for pregnancy with adequate nutritional supplementation: folic acid. Other: choline, iron, DHA, iodine, vitamin D9,[49,65]	Multiple gestation: twins, triplets, quadruplets, sextuplets	Correction of any pre-existing issue/s and adequate food supply [25-28, 33, 34, 37-40, 58, 59-60, 62]
Bariatric surgery (e.g., bilo-pancreatic bypass, Roux-en-Y gastric bypass, lap banding, gastric sleeve)[19]	No planning, not at desirable body weight Adequate nutritional status after bariatric procedure [18, 21, 22, 50-57, 64] Adequate oral contraception after bariatric surgery[23]	Hyperemesis gravidarum (HG)	Knowledge of inherent nutrient deficits in human breast milk and plan of supplementation [61]
Medical conditions (e.g., Crohn's disease, Ulcerative Colitis, HIV, diabetes, PKU, significant food allergies)		Complications arising during pregnancy (e.g., gallstones, emergent issues impacting on overall nutrition)	
Poverty/food insecurity/ displaced persons	Poverty/food insecurity/ displaced persons	Poverty/food insecurity/ displaced persons [25-28, 37-39, 58, 59, 60]	

PREGNANCY

Nutrient Considerations and Risk Factors

Inadequate dietary intake in women can be highly varied, ranging from failure to meet the Dietary Guidelines for Americans, to following trendy diets (e.g., paleo, raw food, etc.), to overconsumption of high-sugar, high-salt, and high-fat foods. These intake patterns may lead to nutrient deficiencies and/or unintended weight loss/gain, and less than optimum pre-pregnancy health status. Vegetarian diets can also be highly variable in nutrient composition based on the type of vegetarian diet and associated strictness (Table 2). Therefore, not all women enter pregnancy nutritionally replete.[9]

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Women'sHealth*REPORT*

1917-2017

Please send any questions or comments to publications@womenshealthdpg.org

The Women's Health Report (ISSN-3233) is an online quarterly publication of the Women's Health Dietetic Practice Group (WH DPG) of the Academy of Nutrition and Dietetics. The WH Report features articles, as well as information on programs, materials, positions, and products for use of its readers. News of members, book reviews, announcements of future meetings, requests for information, or other items of interest to women and reproductive nutrition dietetics practitioners should be sent to the Publications Editor at publications@womenshealthdpg.org.

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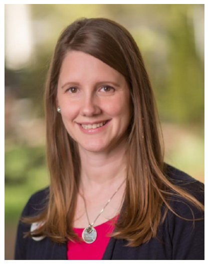


FROM THE CHAIR **Catherine Sullivan,** MPH, RDN, LDN, IBCLC, RLC

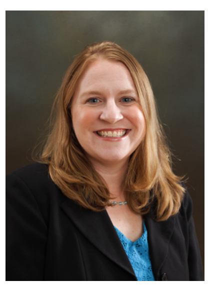
Dear WH Members,

I hope you had a Happy National Nutrition Month! The theme for this year was "Put Your Best Fork Forward", which is such an important message for our practice group. From the lifecourse perspective, women are highly impacted by what they eat in different stages of the lifecycle. Women lay down the foundation for the next generation through their nutrition during pregnancy and lactation. In this issue, Miriam Erick, MS, RDN, CDE will share information about the importance of diet during pregnancy and lactation. We have also featured an article on Nutrition for Breast Cancer Reduction: Past, Present, and Future. Lastly, our review of resources will focus on online lactation training options.

I would like to extend my congratulations to our newly elected officers. Our current treasurer, Dawn Ballosingh, RD, LMNT, MPA will move into the role of Chair Elect, Alena Clark, PhD, MPH, RD, CLC will serve as treasurer, and Julie Buck, EdD, RDN, CD(DONA), LCCE will join the EC as Nominating Committee Chair. I am confident that our practice group will grow and prosper under their leadership.

Our FNCE ® featured Women's Health DPG Spotlight Session on the 4th Trimester: Implications for Assessment and Care of Women with Endocrine Abnormalities was a huge success. Dr. Stuebe will be following up with an article in our next newsletter. Dr. Stuebe and Lindsey Hurd Reeves, MS, RD, LDN, IBCLC, CD (DONA) will be presenting May 23rd via webinar for those of you who missed FNCE. We have had fantastic webinars this spring including; Telehealth, The First 1000 Days: The Nutritional Health of America's Moms, Infants and Toddlers, and PCOS: Updates, Nutrition Strategies and Lifestyle Treatments. You can access the archived webinars on our website. We also have videos from our award winners posted. Take a minute to celebrate your colleagues!

Best, Catherine



FROM THE EDITOR **Kathleen Pellechia,** RDN

Hello WH DPG Members,

This time of year always reenergizes me as I think of Spring days ahead and I celebrate all that I love about the profession of dietetics. I am pleased to bring you Issue 2 of the Women's Health Report featuring an insight into the area of lactation and gestational nutrition by one of our members and past recipient of our Excellence in Practice Award, Miriam Erick, MS, RDN, CDE.

We are also continuing our series focusing on the history of women's health and nutrition in celebration of 100 years of the Academy of Nutrition and Dietetics. In this issue, we talk with Cynthia Thomson, PhD, RD, professor at the Mel and Enid Zuckerman College of Public Health at the University of Arizona and co-author of the Women's Health Nutrition Practice Paper. Dr. Thompson shares with us her thoughts on Nutrition for Breast Cancer Risk Reduction: Past, Present, and Future.

As we look ahead to the rest of this membership year, we will be offering a special double issue with even more content celebrating 100 years of dietetic practice. This issue should arrive to your email boxes by the summer.

We are always looking for authors and content for future newsletters. Send your ideas, comments and suggestions to me at publications@womenshealthdpg.org.

Happy Spring!
Kathleen

Table 2: Vegetarian diets and Potential Risks

Type	Diet includes	Diet avoids	Potential risks
Pescatarian	Fresh and salt water fish, fruits, vegetables, grains, legumes, soy, nuts, eggs, dairy	Land animals; red meats, poultry	High intake of mercury, thiaminase (in raw seafood) which can adversely affect thiamin status
Semi-vegetarian	Vegetables, soy, legumes, nuts, grains, fruit, dairy, seafood, eggs, poultry	Land animals; red meats	Minerals, especially zinc and iron
Ovo-lacto vegetarian	Vegetables, legumes, soy, nuts, grains, fruit, dairy, eggs	Land animals; red meats, poultry, seafood	Minerals, especially iron, zinc, and vitamins, especially vitamin D, vitamin B12
Ovo-vegetarian	Vegetables, grains, legumes, nuts, soy, fruit, eggs	Poultry, dairy, land animals, seafood	Minerals, especially iron, zinc, and vitamins, especially vitamin D, vitamin B12
Vegan	Only plant foods; vegetables, grains, legumes, soy, nuts, fruits	Land animals, dairy, eggs, seafood	Minerals, especially iron, zinc; vitamins, especially D and B12; protein
Macrobiotic (can have up to 10 stages)	Gradual progression to a diet of cereals only, can have high amounts of seaweed	Land animals, fish, poultry, eggs, dairy	Nutritionally inadequate; concern for high iodine content in kelp or kombu

**Adapted from Lawrence 61*

In a 2002 study from Newark, New Jersey, Baker, et al. identified at least five sub-clinical nutrient deficiencies in a population of randomly selected women (n=563), all enrolled in the WIC Program.[10] All sampled women were compliant with prenatal supplementation and assessed by registered dietitians as having adequate diets. A total of 12 nutrients were assessed during each trimester: niacin, thiamin, vitamin A, vitamin B12, vitamin B6, folic acid, biotin, pantothenic acid, riboflavin, vitamin C, carotenes and vitamin E. A population of 83 non-pregnant women, aged 24-36 years, provided reference values. Deficiency details are provided in Table 3.

Baker's research group concluded that an average of 20-30% of pregnant women suffer from at least one vitamin deficiency. Potential etiology of maternal decline of nutrients by trimester, speculated by this author, could be increased fetal growth and development requirements in the setting of decreased intake due to reduced maternal gastric space and early satiety, both prevalent in advanced gestation.

Of the 563 women included in this study, 53 neonates were of low birth weight (less than 1,500 grams). While the researchers attempted to correlate low birth weights, as well as parity and gestational age, with nutrient deficiencies, i.e., niacin, thiamin, vitamin A, vitamin B12 and vitamin B6, they found no statistical correlation using the Wilcoxon rank sum test. The authors speculated that perhaps clearer correlations with factors involving pregnancy outcome with hypovitaminemias might have emerged without prenatal supplementation; however, such a study would have been unethical to perform.[10]

In addition to concerns of nutrient status in singleton pregnancies, multiple gestations increase metabolic demands on maternal stores, and specific nutritional recommendations are provided for twin and triplet pregnancies.[11, 12] Studies also show higher rates of preterm infants and small for gestational age (SGA) neonates born to women suffering from poor nutritional intake due to severe hyperemesis gravidarum (HG),[13,14] with higher rates of learning disorders in these children. HG is defined as severe extreme, persistent nausea and vomiting during pregnancy. There is some speculation that early nutrient deficiencies might play a role in the development of autism,[15,16] given the established relationship between diet, neurotransmitters and brain function.[17]

Special Populations: Post-Bariatric Surgery

One area of concern that has been identified in the literature is nutrition status following bariatric surgery. Bariatric surgery, growing in popularity to address obesity and type-II diabetes, has known consequences in persons poorly compliant with nutritional protocols.[18] Non-adherence to nutritional supplementation after bariatric procedures was studied in 92 subjects after six months and found to be 30%.[19] While most of these individuals were men, this is concerning for both genders. Compliance to with post-bariatric protocols is variable, and is often associated with insurance issues.[20]

However, compliant or not, adequate nutrient levels cannot always be achieved.[21] One case report describes a woman who was compliant with supplementation after a biliopancreatic diversion surgery for obesity for seven years pre-pregnancy as having severe, maternal hypovitaminosis A during gestation. The infant was born with undetectable serum vitamin A levels, which manifested into microphthalmia, inferior adherent leukoma, and optic nerve hypoplasia (malformations of the eye). At nine months of age, electroretinopathy suggested rod dysfunction. It should be noted that the biliopancreatic diversion is the most restrictive procedure available. The gastric sleeve and roux-en-y present less risk for nutrient deficiency but still pose risk due to low adherence to lifetime supplementation protocols. The American Society for Metabolic and Bariatric Surgery provides recommendations for nutrition assessment and monitoring of patients before and after surgery.

Table 3: Mean (+/SD) and Ranges of Blood Vitamin Concentrations of Deficient Nutrients [10]

Nutrient (units as measured in blood test)	Trimester 1 (n=132)	Trimester 2 (n=198)	Trimester 3 (n= 233)	Non pregnant women (n=83)	Amount of nutrient in prenatal supplement
Niacin (µg /mL)	3.7 +/- 0.6	3.4 +/- 0.6	3.2 +/- 0.7	5.2 +/- 0.2	20 mg
--	3.1-5.0	1.9-4.1	1.9-4.1	3.5-6.4	--
Thiamin (ng/mL)	32 +/- 8	33 +/- 9	34 +/- 11	48 +/- 4	3.0 mg
--	18-48	20-49	20-54	26-71	--
Vitamin B6 (ng/mL)	40 +/- 11	41 +/- 15	42 +/- 14	38 +/- 4	10 mg
--	26 - 59	27 – 63	29 -60	32 - 77	--
Vitamin B12 (pg/mL)	306 +/- 180	275 +/- 162	228 +/- 130	366 +/- 77	12 mcg
--	116 – 604	99 – 558	86 – 437	116 - 660	--
Vitamin A (µg /dL)	32+/- 9	32+/- 8	31 +/- 8	44 +/- 7	5000 IU
--	18 – 45	20 – 47	18 -47	27 - 84	--

Deficiencies in iron, vitamin A, vitamin B12, vitamin K, folate and calcium can result in both maternal complications, such as severe anemia, as well as fetal complications, such as congenital abnormalities, intrauterine growth restriction (IUGR) and failure to thrive (FTT).[18]

Phrynoderma and acquired acrodermatitis enteropathica, both skin lesions, have been reported in two women following Roux-en-Y

Continued on page 4

gastric bypass surgeries. One woman was diagnosed with a vitamin A deficiency, and the second with zinc deficiency. [22] Although both women experienced symptoms during pregnancy, clinicians felt the additional nutritional demands associated with lactation further depleted nutrient stores, which worsened lesions and drove the women to specialists for treatment. Nutritionists who counsel women during the preconception period might inquire as to memory, mood, skin changes, night vision, and hair loss along with frequency of bariatric follow-up – all may be indicators of nutrient deficiency.

Absorption of oral contraceptives is altered after bariatric surgery, as weight loss alters the hormonal balance between testosterone and estrogen which increases fertility.[23] There is concern about adequate absorption of oral contraceptive agents after bariatric surgery in the setting of increased fertility with weight loss. Experts recommend adding a secondary agent such as barrier methods to prevent unintended pregnancy. Unplanned pregnancy for a woman already breastfeeding an infant can present challenges to the mother in maintaining optimum nutrition and hydration status.

LACTATION

Composition of Human Milk

Lactation, the process of producing nutritionally appropriate sustenance with immunological benefit, is a physiologically and metabolically demanding activity which occurs after the delivery of an infant. Table 4 provides a summary of the nutrient content of breast milk of a well-nourished woman; however exclusively breastfeeding after pregnancies complicated by HG, multiple gestations, and/or poor nutritional intake may require supplementation with specific vitamins and minerals. If a mother suffered nutritionally during pregnancy, it is likely her breast milk will not be optimal.

Table 4: Nutritional Composition of Human Milk of Well-Nourished Women (per deciliter)

Nutrient	Colostrum (day 1-5)	Transitional milk (lasting for ~2 weeks after colostrum)	Mature milk (>~2-3 weeks)
Vitamin A (µg)	151.0	88.0	75.0
Vitamin B1 (µg)	1.9	5.9	14.0
Vitamin B2 (µg)	30.0	37.0	40.0
Niacin (µg)	75.0	175.0	160.0
Pantothenic acid (µg)	183.0	288.0	246.0
Biotin (µg)	0.06	0.35	0.6
Folic acid (µg)	0.05	0.02	0.14
Vitamin B12 (µg)	0.05	0.04	0.1
Vitamin C (mg)	5.9	7.1	5.0
Vitamin D (µg)	--	--	0.04
Vitamin E (mg)	1.5	0.9	0.25
Vitamin K (µg)	--	--	1.5
Carnitine (nmol/mL)	115	--	70.0-95.0
Calcium (mg)	39	46	35
Chloride (mg)	85	46	40
Copper (µg)	40	50	25-40
Iodine (µg)	12	--	11
Iron (µg)	70	70	100
Magnesium (mg)	4	4	4
Phosphorous (mg)	14	20	15
Potassium (mg)	74	64	57
Sodium (mg)	48	29	15
Zinc (µg)	540	--	120
Cholesterol (mg)	27	--	16
Calories	57.0-58.0	63.0	65.0

**Adapted from Lawrence [63]*

Nutrient Considerations and Risk Factors

Iron. Human breast milk has very little iron – roughly 0.4 mg/L.[4] iron supplementation of exclusively breastfed infants needs to occur by four months if the mother had an uncomplicated healthy pregnancy, as neonatal stores will be depleted.[4, 5] In a study of 68 late preterm infants born between 32 and 35 weeks gestation, iron depletion and iron depletion anemia were present in 38.2% and 30.9% of the infants by 6 weeks post-natal life, respectively. Early supplementation for the late preterm infant with a low birth weight (< 1830 g) and a low serum ferritin (< 155 µg/l) in the absence of infection in the first week of life is needed to avoid iron depletion, which left unremedied could lead to impaired neurodevelopment.[6] It is for this reason that since 2012, the American Congress of Obstetricians and Gynecologists (ACOG) has recommended delayed cord clamping and in 2016 revised its policy to include term infants as well – noting that while preterm infants are likely to benefit the most from the additional blood volume gained from the placenta, term infants can also benefit and these benefits may have a favorable effect on developmental outcomes."[24]

Vitamin B12. This key nutrient is typically found to be depleted in breast milk of impoverished women whose diets are low in animal protein. This is also often the case for those women with unsupplemented vegan diets, as well as for some women after bariatric procedures with poor compliance to nutritional protocols.[19, 25-28] However; vitamin B12 deficiency can result from other conditions as well.

Vitamin D. The vitamin D concentration in breast milk of women taking 400 international units (IU) of vitamin D per day in pregnancy is relatively low, leading to vitamin D deficiency in breastfed infants. The vitamin D activity in normal lactating women is known to be in the range of 5-80 IU depending on method of assay, however, there are variations based on sunlight exposure. The American Academy of Pediatrics (AAP) and the National Academy of Medicine recommend supplementing all (both formula and breastfed) infants with vitamin D; however, compliance to this practice is poor, ranging from 2-19%.[1]

A U.S. study supplementing nursing mothers with 400, 2400 or 6400 IU vitamin D3 daily for 6 months showed that the supplementation of 6400 IU/day safely supplied breast milk with adequate vitamin D to meet the infant requirements, offering an alternative strategy to direct infant supplementation.[1]

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Vitamin K. Breast milk is low in vitamin K.[7, 8] Infants who are exclusively breastfed and do not receive vitamin K at birth are at risk for hemorrhagic disease of the newborn. In one case report, a 4-week-old exclusively breastfed infant presented to an emergency department with lethargy and a grossly dilated right pupil. Trauma was ruled out. A CT scan revealed a right-sided subdural hematoma with mid-line shift. The infant's international normalized ratio (INR) was over 10.9, and his prothrombin time (PT) was over 120 seconds. Vitamin K was administered and the infant underwent a craniotomy, followed by a period of recovery in the intensive care unit, and was eventually discharged. Given that all infants have very low vitamin K stores at birth, it has long been the recommendation of the American Academy of Pediatrics to provide routine vitamin K supplementation via injection to all infants.

The estimated basal metabolic requirement (BMR) of the infant brain, which is roughly 10-11% of total body weight, requires 50% of total daily energy.[29] An approximation of vitamins and minerals of bovine, pork and lamb brains found in food composition tables provides an idea of the nutritional composition of the human brain[30], and why nutrient deficiencies are so devastating.

Zinc. A report from Germany described 10 infants (mean gestational age: 30 weeks; range 25-40 weeks) with zinc deficiency manifesting as erosive, impetiginized periorificial dermatitis at 10 weeks of age (corresponding to gestational age of 41.4 weeks). Initially the cutaneous lesions were misdiagnosed as eczema or impetigo in 8 of the 10 infants, and treated with topical corticosteroids for a mean of 4 weeks before the correct diagnosis was established by decreased serum zinc levels. All infants were exclusively breastfed. Due to the infants' rapid growth, they had increased zinc requirements.

All 10 infants had serum zinc levels below the normal range of 720-1570 µg/L, ranging from 159-567 µg/L. Breast milk zinc levels were found to be below the normal range of 784-2416 µg/L in 3 of the mothers, and 7 of the mothers did not have levels drawn. Two of these 3 mothers had serum maternal zinc levels below the normal range of 600-900µg/L (416 µg/L and 548 µg/L). Symptoms in all of the infants resolved with oral supplementation. The zinc levels of mature breast milk are lower than those of cow's milk (1.18 mg/L vs. 3.9 mg/L), and further decrease during human lactation.31 It is suspected that iron, folate and calcium, which are often routinely prescribed during pregnancy, seem to decrease the oral bioavailability of zinc in pregnant women. Additional research is needed in this area and there are no recommendations at this time for global zinc supplementation for infants.

From a study of 158 infants, aged 6 months, the prevalence of zinc deficiency was investigated by feeding modality: exclusively breastfed, formula fed and mixed fed. Investigators found 14.9% zinc deficiency in breastfed infants, 5.3% in formula fed infants, and 2.9% in mixed fed infants. A higher proportion of mothers of breastfed infants were also found to be zinc deficient.[32]

Special Populations: Poverty

Calories. The macronutrient content of breast milk from undernourished mothers in the resource-poor community of Maracaibo, Venezuela was studied. Forty samples of breast milk were obtained in the emergency room of a pediatric ward from 20 undernourished mothers and 20 well-nourished mothers of children aged 15 days to 6 months. This was a prospective study with no experimental or comparative analyses between the mothers' nutritional condition and the macronutrients found in breast milk of two groups of women.[33] As shown in Table 5, the calorie content of milk from undernourished mothers was much lower. Poverty within the US and around the world impacts women and their families. It is important to assess food security and to remediate via community food supplement programs when access to food (particularly more nutritious food) is limited.

Table 5: Maternal Dietary Components and Nutritional Profile of Breast Milk[33]

Characteristic	Undernourished (n= 20)	Adequately nourished (n=20)
Maternal weight	41.06 +/- 1.3 kg	61.2 +/- 1.2 kg
Fat content of breast milk	3.8 +/- 0.32 g/dL	5.5 +/- 1.08 g/dL
Protein content of breast milk	1.8 +/- 0.21 g/dL	2.4 +/- 0.32 g/dL
Carbohydrate content of breast milk	6.06 +/- 0.43 g/dL	5.7 +/- 0.45 g/dL
Caloric content of breast milk	65.92 +/- 15.16 kcal/L	83.27 +/- 9.4 kcal/L
Portions of milk (by FFQ)	4 or 20%	10 or 50%
Portions of meat (by FFQ)	2 or 10%	9 or 45%
Portions of eggs (by FFQ)	3 or 15%	13 or 65%
Portions of sugar and flour (by FFQ)	15 or 75%	13 or 65%
Portions of fruit (by FFQ)	14 or 70%	8 or 40%

Vitamin B12. Pregnant women in resource-poor areas are at risk for multiple micronutrient deficiencies, and indicators of low vitamin B12 status have been associated with adverse pregnancy outcomes, including anemia, low birth weight and IUGR. To evaluate whether a daily oral vitamin B12 supplement during pregnancy increases maternal and infant measures of vitamin B12 status, researchers in Bangalore, India randomly assigned women to receive either a vitamin B12 supplement or placebo from < 14 weeks to 6 weeks postpartum. Women in both groups received iron and folic acid supplements – Table 6 provides data. [34]

Continued on page 6

Stay tuned to your email for a jam-packed double issue 3/4 early this summer. We will be continuing our look at 100 years of women's health and nutrition including how breastfeeding gear has changed through the years.

APPLY FOR A WH DPG AWARD
for more information visit
http://womenshealthdpg.org/awards/
Deadline is June 1st!

Table 6: Impact of Maternal Vitamin B12 Supplementation on Breast Milk and Infant Serum B12 Levels[34]

Characteristic	Vitamin B12 (n=183)	Placebo (n=183)
Prescribed amount	50 µg	--
Trimester 2 serum B12	216 pmol/L	111 pmol/L
Trimester 3 serum B12	184 pmol/L	105 pmol/L
Breast milk B12 at 6 weeks	136 pmol/LL	87 pmol/L
IUGR	25% (33 of 131 babies)	34% (43 of 125 babies)
Infant serum B12)	199 pmol/L	139 pmol/L

In a clinical report from Ankara, Turkey, 20 infants (11 girls, 9 boys) with a mean age of 6.65 +/- 4.5 months were evaluated for vitamin B12 status. All infants were breastfed, documented to be vitamin B12 deficient, and presented with various symptoms: 30% with infections; 25% with pallor; 25% with hypotonia and neuro-developmental delay; 20% refused solid food and/or to suck; 15% with FTT; and 10% with fatigue. All mothers were also identified as vitamin B12 deficient due to low socioeconomic status, living in resource-poor rural areas.[26]

Experts suggest it is useful to categorize nutrients into two groups during lactation. Group I nutrients (thiamin, riboflavin, vitamin B6, choline, retinol, vitamin A, vitamin D, selenium and iodine) are of the most interest in public health nutrition because their secretion into milk is rapidly and/or substantially reduced by maternal depletion. Maternal supplementation with these nutrients can increase breast milk concentrations and improve infant status. In contrast, the concentrations of Group II nutrients (folate, calcium, iron, copper and zinc) in breast milk is relatively unaffected by maternal intake or status. The mother gradually becomes more depleted when intake is less than the amount secreted in milk, and maternal supplementation benefits the mother rather than the infant.[35]

Veganism (chosen or circumstantial). In a review of the literature of nutritional adequacy in vegetarian women, vitamin B12 deficiency among pregnant women ranged from 17 to 39%, dependent on the trimester.[25] The deficiency prevalence among breastfed infants reached 45%, with offspring of women with vegan diets being at high risk.

In a report from a hospital in Prague, Czech Republic, pediatricians followed 40 children who were referred for FTT. Serum vitamin B12 of the 40 lactating, asymptomatic women showed levels at 122 +/-52 ng/L (normal range 250-900 ng/L) with breast milk levels of B12 at 64+/- 17 ng/L. Seventeen infants were profoundly deficient in cobalamin (Cbl) with serum levels of 69 +/-17 ng/L, and 23 infants with mild Cbl deficiency serum levels were noted to have levels at 167 +/- 40 ng/L. Maternal Cbl deficiency may be caused by achlorhydria, Helicobacter pylori infection, celiac disease, Crohn's disease, pancreatic insufficiency, treatment with proton pump inhibitors, or insufficient vitamin B12 from limited servings of animal proteins or vegan diet. Cbl deficiency in adults may present as megaloblastic anemia, polyneuropathy, and sub-acute combined neurodegeneration of the spinal cord, dementia or depression. The clinical impairment of the adult nervous system develops slowly over months or years. In contrast, vitamin B12 deficiency can cause severe impairment in the neonate who is undergoing rapid growth and may present within weeks. Anthropometrics, e.g., weight and length, begin to decline long before other clinical presentation appears. FTT was present in 15 of the 17 severely deficient infants. Maternal Cbl deficiency can also be caused by insufficient Cbl absorption. In this group of subjects only 6 (15%) mothers were vegetarian.[27,36]

While not specific to the vegan diet, an investigation by Dijkhuizen, et al. in West Java, Indonesia assessed 155 lactating mothers and their healthy infants anthropometrically and biochemically for vitamin A and zinc via serum, urine and breast milk samples.[37] The researchers demonstrated that nutritional deficiencies in the mother and infant do not have parallel biochemical parameters. The infants on physical examinations were designated as appearing "healthy." Table 7 below provides data.

Table 7: Mothers vs. Neonate Nutritional Deficiencies[36]

Nutrient Deficiency	% of mothers affected	% of infants affected
Vitamin A	18	54
Zinc	25	17
Iron	50	n/a

Antibodies. Breast milk output is lower in malnourished women by about 30%. This reduction corresponds to a lower ingestion of immunoglobulins by the infants of malnourished women.[38] Serum and human milk antimicrobial antibody titers were measured longitudinally in 17 malnourished and 14 control Zairian women during 6 to 18 months of lactation to test whether malnutrition was associated with an impaired secretory antibody response. No decrease in antibody content was found in the malnourished women when compared with controls.[38]

It has been demonstrated that breast milk is lower in antibodies from malnourished women by 30%. A lower level of antibodies in breast milk translates to lower ingestion of immunoglobuins by the infant. While it is not possible to supplement women with antibodies, improving the nutritional status of malnourished women can help improve antibody level. Nutrients involved in immune function include vitamin A, C, D and E, as well as zinc, selenium and iron.[39,40]

Thiamine. During a prospective evaluation of a malaria prophylaxis program in a refugee population in northwestern Thailand between 1987 and 1990, an extremely high infant mortality rate (18%) was documented despite good access to health care. Infantile beri-beri was identified as causing 40% of all infant mortality, and the likely cause was thiaminase activity from raw fish, a typical dietary item, consumed by the lactating women. Vitamin B1 deficiency was detected in 60% of the plasma samples of the breastfeeding mothers. Other sources of thiaminase include betel nuts and ferns besides raw fish and raw shellfish.[41,42]

Other. Adequate intake of healthy fats alters the saturated fatty acid profile of milk, and can improve omega 3 fatty acid profile for the infant.[42,43] Supplementation with vitamins C and E also improves the total antioxidant content of human breast milk[44]; however, education should encourage adequate consumption of healthy foods first before turning to supplements. Additionally, maternal diet influences iodine content of breast milk and is highly variable. Women consuming large amounts of seaweed may have excessive levels of iodine in breast milk.[45]

Conclusion

The RDN and/or international board-certified lactation consultant (IBCLC) can provide comprehensive assessment of dietary intake

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in women who may have some degree of gestational malnutrition. Many of the studies included in this review were in other countries so their relevance to the US population may not be applicable. However, RDN's should assess all post-partum dyads for their risk. Obstetricians may not be anxious to order nutritional labs when the woman is newly postpartum and discharge is eminent. In this case, it is imperative to communicate with the pediatric and/or family medicine staff on potential nutritional compromise. Providing adequate energy, plus a full complement of vitamins, minerals, for the exclusively breastfed baby, is the goal of a quality maternal diet.[43,46,47]

At-risk mothers include those who have experienced HG, multiple gestations, bariatric surgery, or those with financial hardship. Maternal symptoms of nutritional deficiency are often late to manifest, but many nutrient deficiencies can present as FTT in the infant in as few as 2 months postpartum in the full-term, exclusively breastfed infant. By sharing current evidence-based guidance with women who are pregnant or trying to become pregnant on the importance of achieving optimum nutrition and health status for pregnancy and lactation, the RDN can help to ensure a positive health outcome for both the mother and her infant.

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WH DPG MEMBER SPOTLIGHT By Lauren Manaker, MS, RD, LD

***Miriam Erick** is a registered dietitian-nutritionist, CDE, at Brigham and Women's Hospital, Boston, providing nutritional care for high-risk antenatal and postpartum women in addition to orthopedic and cardiac step down patients. A significant contribution to maternal care happened as a result of her first book No More Morning Sickness in 1993 when she organized an outpatient Morning Sickness Nutrition Clinic as a collaborative service between the Departments of Nutrition and Obstetrics. Her work was instrumental in identifying a young girl with vitamin K embryopathy whose mother had severe hyperemesis gravidarum during pregnancy, resulting in publication of these findings (Torielli H et al). Miriam contributed two of the twelve nutrition posters presented at the First World Colloquium on Hyperemesis Gravidarum in Bergen, Norway in 2015, and plans to share a new poster for the Second World Colloquium in the UK in October 2017.*

Tell us a little about your professional journey, and how you became interested in women's health.

Nutrition is not my first career. I started out in business and found it unsatisfying. I went back to school part-time to take required courses in nutrition for a dietetic internship, and then trained in Boston where I spent a lot of time with sick pregnant women diagnosed with hyperemesis gravidarum (HG) and diabetes. I had no plans to focus on women's health-nutrition—it just happened.

What motivated you to start a morning sickness clinic, and author a book on the same topic?

The book came first, and was followed by the clinic. I'd collected heaps of stories from my sick women of what foods were working, which, at the time, was almost heresy! I saw dozens of sick women a month and thought, "Isn't there a way to see them BEFORE they get that sick?" I made a proposal to my director and chair of OB, and both were interested.

What advice would you give other RDNs who have interest in authoring a book, as you have successfully done four times?

Writing is painful! Expect many drafts, and expect to flounder from time to time. Rather than set your sights on a book, try for something easier, like Letters to Editors, most of which are allowed only 400 words and four references – you are forced to write concisely.

What is the most rewarding part of what you do and why?

When I can help the team crack the code on a case of severe morning sickness, that "ah-ha!" light bulb goes off for everyone. One of my patients suffering from HG made medical literature with a vitamin K deficiency. Years later, I tracked down that woman's baby who also had a vitamin K deficiency, but with a different presentation. We wrote up the case in a 2013 article published in the American Journal of Medical Genetics in a series of other vitamin K embryopathies of children of sick mothers (Toriello, et al.). I haven't written that many major papers, but I share these with the team to try to prevent needless suffering all around. I also send various nutrition abstracts and articles to the teams I work with to keep us all in the loop.

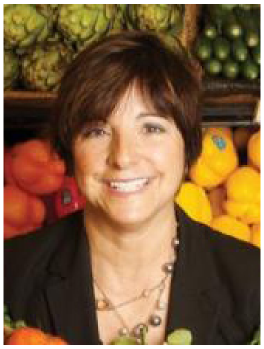
You have had experiences participating in international medical and nutrition conferences. Do you have a favorite experience or takeaway message from your time at these events?

I've only been to Bergen, Norway so far for an international nutrition conference, so I can't say! I brought two of the twelve posters which were displayed, and received many compliments. Of course…the two I presented I was making up as I was going along—the thoughts came sort of out of the blue from trying to find information I thought we all needed. One of these posters was on nutritional composition of the brain and my thoughts on why there is so much Wernicke's encephalopathy with HG. The other discussed all of the fetal anomalies of malnutrition – it's NOT just folate! I dug until I found a reference for most nutrients and was amazed! It was really exciting to discover "new" things!

Any other advice you would give any RDN interested in focusing more on women's health?

Not everything you read provides "the answers." Dig into various corners of the literature yourself. If something isn't "there," use the next best thing. Also, talk to your patients with an open mind. I have found that the hyperemesis women teach me so much more than the early literature I collected. Think of yourself like a nutritional anthropologist--- always on the "hunt!

NUTRITION FOR BREAST CANCER RISK REDUCTION: Past, Present, and Future By Lee Crosby



An Interview with Cynthia Thomson, PhD, RD

In honor of the Academy of Nutrition and Dietetics' (Academy) centennial celebration, each 2017 issue of the Women's Health Report is featuring content related to 100 years of women's health and nutrition. This issue, we focus on the evolution of nutrition in preventing one of the most common women's health conditions: breast cancer.

While it's well known that breastfeeding can help reduce breast cancer risk,[1] the physician Galen of Pergamum identified diet as a risk factor for breast cancer in the second century AD.[2] In particular, he believed dairy products were protective, while meat increased risk.[2] Nearly two millennia later we have come to learn that he was somewhat on track. Not only does diet play a role in breast cancer risk, but studies have specifically linked the consumption of red meat during puberty and early adulthood to increased risk of breast cancer later in life.[3,4]

In just the last few decades, nutrition for breast cancer prevention and survivorship has made it onto the research radar, and significant strides have been made in advancing our understanding of this disease. To learn more, Women's Health Report spoke with Cynthia Thomson, PhD, RD – a long-time researcher in nutrition for breast cancer prevention. Dr. Thomson is a professor at the Mel and Enid Zuckerman College of Public Health at the University of Arizona and co-author of the Academy's Women's Health Nutrition Practice Paper.

How did you begin research into breast cancer nutrition? I was working as an oncology clinical dietitian at the university hospital here in Tucson, and was assigned patients who were undergoing bone marrow transplants for breast cancer – a treatment that's less common now, as data don't routinely support it. I specifically remember one young lady who received a bone marrow transplant. At that time, access to patients was limited due to concerns about infection risk. This woman had two children, and she couldn't even touch them. They would just look at her through the glass, and I remember thinking how much I wished we could prevent this disease. I called a colleague, Cheryl Ritenbaugh, PhD, who worked in the field, and she made introductions and helped me transition into research.

What was the state of nutrition for breast cancer prevention when you entered the field? In the late eighties and early nineties, there were no expert panels or consortium opinions. The focus was primarily on reducing fat due to results of epidemiological studies. Specifically, studies had shown that when women migrate from Asia to the U.S. and eat more fat, they experience more breast cancer. So dietary fat was really the driver.

Who were some of the research pioneers in this area, and what were they working on at the time? Nutrition professionals were integral to the first three large randomized controlled trials looking at the effects of diet on breast cancer risk: the Women's Health Initiative (WHI), Women's Healthy Eating and Living (WHEL) study, and Women's Intervention Nutrition Study (WINS). [See sidebar for study details.] All began enrolling participants in the 1990s, and I had the opportunity to engage in work on all three. For WHI, Lesley Tinker, PhD, RD, Ruth Patterson, PhD, and Marian Neuhouser, PhD, RD, were instrumental. Cheryl Rock, PhD, RD, was a key player on WHEL. And Abby Bloch, PhD, RD, among other dietitians at Memorial Sloan-Kettering Cancer Center, were pivotal to the success of WINS.

As for physician scientists, David Alberts, MD, still a practicing oncologist with the University of Arizona, definitely helped break ground. He's one oncologist who has always valued healthy eating and physical activity, and believed lifestyle has a lot to do with not only preventing cancer but reducing morbidity and mortality after diagnosis. He helped design WINS and WHEL, and, importantly, he's a huge cheerleader for dietitians and other health care providers in providing comprehensive care to cancer patients.

How has research been translated into practice today? While we still don't have breast cancer-specific nutrition guidelines, we do have general cancer prevention guidelines from the American Cancer Society, American Institute for Cancer Research, and the National Comprehensive Cancer Network. Certainly recommendations for reducing general cancer risk help to reduce breast cancer

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KEY BREAST CANCER NUTRITION TRIALS

Below are summaries of three large, trailblazing trials in nutrition for breast cancer, along with the year enrollment began for each.

Women's Health Initiative/WHI *(1993).* The WHI broke ground as the first large randomized controlled trial (RCT) to test the impact of diet on breast cancer risk. The diet arm included 48,835 women, with 40% randomized to a low-fat diet (20% of calories from fat), and 60% consuming their normal (control) diet. Women were followed an average of 8.1 years. The low-fat diet did not significantly reduce breast cancer risk on the whole, but trends suggested it did decrease risk for women with high fat intake at baseline, as well as for women with certain types of tumors.[5]

Women's Intervention Nutrition Study/WINS *(1994).* WINS was the first large RCT to look at nutrition in breast cancer survival. The trial tested the effect of a low-fat diet (target was 15% of calories) on relapse-free survival. The 2,437 women participating were 48-79 years old, and all had been diagnosed with breast cancer. Despite a short 5-year follow-up due to a loss of funding, researchers found a 24% lower risk of relapse among those on the low-fat diet.[6]

Women's Healthy Eating and Living Study/WHELS *(1995).* This RCT studied 3,088 women diagnosed with breast cancer aged 18-70 years old. Intervention women were encouraged to eat a diet low in fat (15-20% of calories) and high in vegetables, fruit, and fiber; control women learned 5-A-Day guidelines. Over 7.3 years of follow-up, the WHEL diet did not lower overall risk of recurrence or mortality. However, target fat intakes were exceeded throughout the study,[7] and diet change did benefit some subgroups. For example, women taking tamoxifen who had high intakes of total vegetables and/or cruciferous vegetables had a much lower risk of recurrence.[8]

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risk, too. Moreover, the guidelines are relatively consistent with what we would advise for preventing diabetes, heart disease, and hypertension. That's important, because most breast cancer survivors aren't going to succumb to breast cancer; they more often die from earlier onset of cardiovascular disease.

Thanks to the efforts of the Academy's Oncology DPG and the National Academy of Medicine I think we're moving toward routine nutrition assessment and intervention for all cancer survivors. Because the evidence to date certainly shows that nutrition education and counseling can change outcomes for many cancers.

Where do you see nutrition for breast cancer prevention headed? Right now, there's a lot of focus on controlling insulin levels and inflammation. We know that diet can influence these, and we also know that drugs that control insulin levels or even anti-inflammatories seem to be protective when it comes to cancer. I think we'll see research that looks to optimize a drug's effectiveness with nutritional counseling. We'll start to work with pharmacists and physicians even more closely to set a "minimum effective dose," and then use diet to amplify the effects. That way we can have less toxicity from the drug, while enhancing the beneficial effects of diet.

Also, the National Institutes of Health is undertaking an enormous precision medicine initiative called "All of Us." The goal is to combine robust genetic and phenotypic data so we can really start refining who goes on what meds, who goes on what diet, and assure preventive strategies are tailored for precision medicine approaches.

What resources do you recommend for more information on nutrition for breast cancer prevention? Some guidelines based on current evidence include:

- Nutrition and Women's Health Practice Paper (Academy)
- Summary of ACS Guidelines on Nutrition and Physical Activity for Cancer Prevention (American Cancer Society)
- Research Recommendations for Cancer Prevention (American Institute for Cancer Research)

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DR. THOMSON'S TOP 3 RECOMMENDATIONS FOR BREAST CANCER RISK REDUCTION

1. Reduce or eliminate alcohol. For prevention, it's important to exercise moderation, and perhaps even less than moderation – for instance, as little as one drink per week.

2. Prevent adult weight gain. As you age, incremental weight gain, especially if you are already overweight, can quickly add up and therefore be more difficult to lose. When you gain five pounds, pay attention. When you go up a clothing size, you should work to get back.

3. Eat a variety of vegetables and plenty of fiber. Not only does fiber help control your hormone levels (70%+ of tumors are hormone responsive), the fiber and other bio-actives (carotenoids and flavonoids for example) found in vegetables can help reduce inflammation and oxidative stress. There are literally hundreds of different mechanisms by which the compounds in vegetables can reduce the risk of breast cancer.

WH DPG RESOURCE REVIEW: Lactation Training Programs

By Jessica G. Redmond, MS, RD, FAND

Lactation Education Resources: http://www.lactationtraining.com/

This website emerged from a lactation training program at Georgetown University Medical Center. All of the trainings offered by Lactation Education Resources are offered online, and continuing education credits are available for Registered Dietitian Nutritionists in such courses as "NICU Breastfeeding Training". A Lactation Consultant Training Program is offered, with up to 90 CPEUs available. It leads to the "Breastfeeding Specialist Certificate". For those looking to become an IBCLC, this online program provides 90 hours of required training. Two separate review courses are offered for the IBLCE Exam, offering 3 or 23 CPEUs.

In addition to the online training materials for health professionals, Lactation Education Resources also offers educational handouts that can be downloaded for free. Patient handouts are available in English, Spanish, Chinese, and Arabic. Power Point presentations can be purchased for use.

Galactablog: https://galactablog.com/lactation-training/lactation-certification-programs/

This blog post maintains a current list of Lactation Training programs that are offered entirely online as well as in-person or a hybrid of both delivery options. Completion of any of the programs listed will contribute hours toward the 90 hour requirement for IBCLC eligibility. Many of the programs offer some type of certificate, but none lead directly to IBCLC credentialing.

Whether you are an experienced RDN looking to add the IBCLC credential, or an RDN new to the area of maternal nutrition and lactation, there are several great options for online education that will also earn you CPEUs.

Omega-6 to omega-3 fatty acid ratio in breast milk and infant fat deposition

Rudolph MC, Young BE, Lemas DJ, Palmer CE, Hernandez TL, Barbour LA, Friedman JE, Krebs NF, MacLean PS. Early infant adipose deposition is positively associated with the n-6 to n-3 fatty acid ratio in human milk independent of maternal BMI. ***International Journal of Obesity****. 2017;41(4):510-7.*

Obesity rates among women of childbearing age and children have increased dramatically in recent decades,[1] and maternal obesity increases the risk of child obesity. Exclusive breastfeeding decreases the risk of childhood obesity, but the mechanisms by which this occurs are not yet understood and are influenced by maternal weight status.[2] One possible factor that may play a role is the fatty acid (FA) composition of breast milk. FA content of breast milk is influenced by both maternal body mass index (BMI) and maternal diet. Furthermore, polyunsaturated FAs (PUFAs) in breast milk are known to be bioactive substances that regulate adipogenesis.[3] Interestingly, the relative amounts of n-6 and n-3 PUFAs in breast milk have changed in recent decades, similar to the changes observed in the general Western diet.[3] This trend is notable because high n-6 FA intake (at levels similar to U.S. dietary intake) increases adipose tissue expansion in offspring in animal studies,[4] and thus, may have implications in childhood obesity risk. The study highlighted in this issue's Research Brief, conducted by Rudolph et al.,[5] aimed to assess whether exposure to high n-6 to n-3 FA ratios due to either maternal obesity or maternal diet would be reflected in infant fat deposition in the first 4 months of life.

The researchers enrolled 48 pregnant women who had a prepregnancy BMI < 40 kg/m2, intended to breastfeed for at least 4 months, and were otherwise healthy. Women were excluded if they developed diabetes or delivered preterm. Participants were categorized by maternal prepregnancy BMI group: normal weight (n=26, 18.5-24.9 kg/m^2), overweight (n=12, 25-29.9 kg/m^2), and obese (n=10, = or > 30 kg/m^2).

Mother-infant dyads were assessed at 2 weeks and 4 months postpartum. These time points were selected to represent the periods for of transitional milk and established milk. Maternal fasting blood and mid-feed human milk samples were collected. The mothers completed a modified version of the Infant Feeding Practices II questionnaire to capture information about breastfeeding exclusivity, and reported use of fish oil and other supplements. Additionally, infant weight and body fat were measured using air-displacement plethysmography (PEA POD).

Both human milk samples and maternal red blood cells (RBCs) were analyzed for lipid content. RBC FAs are a well-established biomarker for dietary FA intake for the preceding 3 months. Total triglycerides, total n-6 FAs, n-3 FAs, arachidonic acid (AA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) were quantified.

Statistical analyses were completed to assess differences in human milk and RBC FA composition between maternal BMI groups and between study time points using ANOVA with Tukey's correction for multiple comparisons. Pearson tests evaluated correlations between maternal BMI and FA ratios in human milk and RBCs at both time points. Multivariable linear regression was used to analyze predictors of infant adipose deposition between 2 weeks and 4 months. The primary outcomes were the changes in the infants' absolute fat mass and in body fat percentage, and the human milk AA/DHA+EPA ratio was the predictor tested. Covariates included gestational weight gain, maternal prepregnancy BMI, infant sex, maternal fish oil supplementation, birth weight, and breastfeeding exclusivity.

The mothers who participated were between 20 and 36 years old, and there were no differences observed in age, mode of delivery, parity, gestational age, or breastfeeding exclusivity scores between maternal BMI groups. At 4 months there was a trend for lower breastfeeding exclusivity in the obese group compared to the normal weight group. Infants of overweight mothers were significantly heavier than those of normal weight mothers at 2 weeks, and heavier than infants of both normal weight ($p<0.001$) and obese ($p=0.03$) mothers at 4 months.

In transitional (2-week) human milk, there were no differences in triglycerides, but in established (4-month) milk, the overweight group had significantly higher triglyceride levels than the normal weight and obese groups. For AA/DHA+EPA ratios, normal weight mothers had levels that were a third lower at 2 weeks than overweight and obese mothers, but at 4 months the normal weight mothers' ratios were only lower than the obese group. Absolute DHA levels in human milk were consistently highest in the normal weight group; 43% higher than the obese group at 2 weeks, and 65% higher than the obese group at 4 months. The absolute amount of DHA in the milk of the overweight group was between those in normal weight and obese groups. Importantly, while prepregnancy BMI was moderately correlated with AA/DHA+EPA in human milk at 2 weeks and 4 months, and was moderately correlated with AA/DHA+EPA in RBCs at 2 weeks, the ratios in human milk and RBCs were strongly positively correlated at both time points. Overall, as maternal prepregnancy BMI increased, n-6 FAs in the human milk increased, and the AA/DHA+EPA ratio in human milk was strongly correlated with maternal dietary FA intake.

Infant fat mass, when stratified by the human milk AA/DHA+EPA ratio, was significantly greater in the upper tertile compared to the lower tertile ($p=0.019$); although, there was no difference in fat-free mass. Interestingly, when infants were stratified by maternal prepregnancy BMI, no difference in fat mass was present. In regression models, the change in infant fat mass and percent body fat were significantly predicted by the AA/DHA+EPA ratio in established human milk when controlling for covariates. For every 1-unit increase in AA/DHA+EPA ratio, there was an associated 287g fat mass or 4.7% body fat increase. Thus, the higher the human milk AA/DHA+EPA ratio, the greater the infant adipose deposition.

The finding that higher AA/DHA+EPA ratio in human milk corresponds with larger infant fat mass complements previous findings that preterm infants who consumed DHA-enriched formula had less fat mass.[6] Additionally, maternal obesity affected human milk lipid composition; less DHA was present in the milk of obese mothers both in transitional and established milk. This finding is consistent with,

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and builds on, research in rodents in which de novo lipid synthesis was impaired.[7] Finally, evidence suggested that maternal dietary intake of DHA lowered the AA/DHA+EPA ratio in human milk. This indicates that higher maternal intake of DHA has the potential to protect infants against excess gain in adipose mass, and thus, decrease childhood obesity risk.

The longitudinal nature of this study was a strength, as it allowed sample collection and assessment at two time points. Milk FA composition is known to vary by lactation stage, and two infant assessments provided data on changes in body fat. This study would have been improved by a larger sample size, longer follow-up period, and collection of other information about milk composition.

There are several take-away messages from this study for dietitians practicing in women's health. First, maternal health and BMI status may affect the milk composition, particularly in regard to lipids. Second, maternal dietary intake, regardless of BMI, is likely to affect milk lipid composition. Finally, these effects on milk composition appear to affect infant adipose deposition in the short-term, which may have longer-term implications for childhood obesity risk. These findings emphasize the importance of considering consumption of "healthy fats" beyond simply saturated versus unsaturated; consuming omega-3 FAs, especially DHA, during pregnancy and lactation may be particularly beneficial to the health of future generations.

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